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APPLICATION OF MOWRER'S AUTISTIC THEORY TO THE SPEECH HABILITATION OF MENTALLY RETARDED PUPILS.

BY- RIGRODSKY, S. AND OTHERS
PURDUE UNIV., LAFAYETTE, IND.
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A SPEECH THERAPY METHOD FOR MENTAL RETARDATES WAS DEVELOPED AND EVALUATED. THE METHOD WAS BASED UPON THE ESTABLISHMENT OF FAVORABLE ASSOCIATIONS IN THE CHILD BETWEEN THE WORDS AND SOUNDS OF LANGUAGE AND THE PRODUCER OF THE LANGUAGE, USING STIMULUS-REWARD AND SITUATION-REWARD PRINCIPLES. TRADITIONAL METHODS OF SPEECH THERAPY WERE ADMINISTERED, ALONG WITH THE EXPERIMENTAL METHOD TO GATHER CROSS-COMPARATIVE STATISTICS. TAPE RECORDINGS WERE GATHERED OF STANDARD ARTICULATION TESTS ADMINISTERED TO THE SUBJECTS BEFORE AND AFTER THEIR EXPOSURE TO ONE OF THE SPEECH THERAPEUTIC METHODS. SUCH VARIABLES AS AGE, SEX, IQ, SOCIAL QUOTIENT, READING READINESS, AND THE EXTENT OF FAMILY INFLUENCE WERE CONSIDERED AND TESTED. FAVORABLE RESULTS WERE SHOWN BY POST-TESTING IN BOTH ARTICULATION IMPROVEMENT AND OVERALL BEHAVIOR OF SUBJECTS EXPOSED TO THE EXPERIMENTAL THERAPY WHEN CONTRASTED TO THE CONVENTIONAL THERAPEUTIC RESULTS. THE EXPERIMENTAL PROGRAM INCREASED THE WILLINGNESS OF THE RETARDATE TO COMMUNICATE AND, TO SOME EXTENT, THE MOTIVATION TO COMMUNICATE WELL. (JH)

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APPLICATION OF MOWRER'S AUTISTIC THEORY TO THE SPEECH HABILITATION OF MENTALLY RETARDED PUPILS

Prepared By:

S. Rigrodsky
T. D. Hanley
M. D. Steer
Director

Purdue University
Lafayette, Indiana
Project PU 117

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ABSTRACT

An experiment was conducted, testing the effectiveness of two methods of articulation therapy (experimental and conventional) applied by two therapists to two intellectual levels of retardates in a state school for the retarded. Results of therapy were tested by three articulation tests, a test of clarity of spontaneous speech, and scrutiny of the misarticulations of two consonant sounds (the objects of therapy) within the criterion articulation tests. Control groups of subjects were used to provide a basis for judging the effectiveness of therapy.

The experimental method of articulation therapy tested was based upon the Autistic Theory of Language Development enunciated by Mowrer. In essence, the basic hypothesis of this theory is that language development depends upon favorable associations being established in the learner between language generally (words and sounds specifically) and the producer of the language. When the method was applied in the present experiment, the principle of stimulus-reward and situation-reward was employed. The therapists devoted much more than usual effort to the creation of a favorable emotional environment for the application of speech therapy and they provided tangible rewards (e.g., candy) as they,

the therapists, produced the consonant sounds that were the objects of therapy.

In some contrast, the conventional therapy against which the experimental method was tested relied upon response-reward (correct sound production by the subjects).

Analyses of covariance, having the effect of equating for initial differences among therapy and control groups, were used to test for the significance of observed post-therapy differences on the criterion tests. In addition, correlational analyses were employed in efforts to isolate independent variables which might have contributed to the post-therapy articulation scores. Such variables as age, sex, I.Q., Social Quotient, reading readiness, and the apparent extent of family influence on the subjects were considered and tested.

The results of the experiment were viewed in two different frames of reference. First, the statistical evaluations were taken into account and conclusions based on them appear below. Second, the clinical observations of the therapists and resident experimenter were examined and certain conclusions were drawn. These, too, appear in succeeding paragraphs.

Certain positive trends were found to recur frequently in the data. While rigid interpretation of the statistical analyses will not, in general, justify broad inferences concerning the effects of therapy in this sample, it is evident that changes occurred in subject performance over the period of time occupied by the program of therapy. Some of these changes are revealed in specific conclusions cited below.

Subject to the limitations cited in the body of the report, the following conclusions, for which statistical significance was demonstrated, are offered:

A. When an object articulation test is used to evaluate the results of therapy, mentally retarded subjects of the upper intellectual level achieve better adjusted mean scores than the lower level subjects;

B. When a picture articulation test is used to evaluate the effects of therapy, a therapist by method interaction (demonstrated here) may occur. In this instance, the subjects assigned to experimental therapy under the female therapist achieved better scores than their conventional therapy counterparts, while the reverse situation was characteristic of subjects assigned to the male therapist;

C. When the misarticulations of medial /θ/, reported as adjusted mean scores following a program of therapy are examined, the upper level subjects are seen to achieve better scores than the lower level subjects;

D. When a t-test of significance is applied to the difference between pre- and post-therapy mean articulation score for the initial /v/ sound in the upper level subjects, the articulation of the sound is seen to have improved;

E. When the misarticulations of medial /v/, reported as adjusted mean scores following a program of therapy are examined,

  1) mentally retarded subjects of the upper intellectual level are seen to achieve better scores

than those of the lower level, and
2) there is a possible interaction (demonstrated here) of therapist with method of therapy. In the present instance, subjects assigned to the experimental therapy under the female therapist achieved better scores than those assigned to the conventional therapy, while the reverse was noted for subjects assigned to the male therapist;

F. When independent variables are examined by correlational analysis for their relations to the dependent variables (post-therapy articulation scores),
   1) pre-therapy articulation score is seen to be closely related to post-therapy score, and
   2) reading readiness and I.Q. also are seen to be significantly related to post-therapy score;

G. When independent variables are combined in a multiple correlation coefficient,
   1) the combination of pre-therapy score with family influence is seen to enhance the predictive value of the coefficient, auditory stimulus test score being the dependent variable, and
   2) the combination of pre-therapy score, age (negatively related) and reading readiness is seen to enhance the value of the coefficient, articulation of medial /v/ being the dependent variable.

In the second frame of reference, that of clinical observation, the experiment was seen as a very satisfactory test of the efficacy of the experimental approach to speech therapy with retardates. Despite the inexperience of the therapists and the untried nature of the method, it did not suffer in comparison with a standard clinical methodology.

Moreover, even in the hands of the therapist who used it with less success, it was very favorably regarded in terms of the over-all behavior of the subjects exposed to it. They were more favorably disposed toward therapy in general and the therapists in particular than their stimulus therapy counterparts; they became more spontaneously verbal than the other subjects. In short, they became examples of the application of successful therapy in the mentally retarded environment.

APPLICATION OF MOWRER'S AUTISTIC THEORY TO THE SPEECH HABILITATION OF MENTALLY RETARDED PUPILS

INTRODUCTION

In recent years there has been a growing interest in the educational, social and psychological problems of mentally retarded institutionalized children and adults. New curriculums and psychoeducational techniques have been created and adapted for the needs of this special group. This interest has been extended into the field of speech pathology. A comparison of the research completed during the last decade with that which was completed in the past thirty years reveals a significant increase in the number of Masters and Doctoral projects concerned with this problem.

The concept of a multi-causality of mental deficiency has been one of the major motivating forces responsible for the intensive research and therapeutic programs. Modern institutions for the mentally retarded have developed team approaches involving various disciplines to evaluate the dynamics of an individual case. Sarason (53), reviewing some of the possible developmental factors and causalities related to mental deficiency, states that:

> The significance of these results seems clear; the child who is not consistently and satisfyingly stimulated by people in his environment, whose responsiveness is neither encouraged nor rewarded, and who experiences these lacks during a period when language, motor patterns, and self-attitudes (dependent on language) are ordinarily acquired--such a child will tend to fail to develop normally according to developmental scale..

The American Association on Mental Deficiency (12) in their meeting of the Committee on Nomenclature, discussed the complexity of etiological classification of mental retardation by stating:

> The following classification is based on the premise that mental retardation is basically a symptom complex resulting from a wide variety of conditions including not only defects of the central nervous system but also those in the psychological and sociological speres. While the later conditions are recognized as causative mechanisms in their own right, they may also, and frequently do, play significant roles in influencing the degree and nature of the mental retardation resulting from cerebral defects.

One of the basic tenets of rehabilitation has been adequate diagnosis. In conjunction with the development of better diagnostic techniques and the multi-causality principle, there has been a corresponding increase in interest in rehabilitation. These principles have been extended into programs at institutions for the mentally retarded; as a result the professional and custodial staffs are being trained to view mental retardation as a condition that can be often ameliorated. Half-way houses, whose purpose is to simulate 'outside' environmental conditions for individuals who are being prepared for discharge, have been inaugurated in a number of institutions. Preventive medicine, medical care and academic skills are being introduced to prepare the younger population for eventual discharge.

Difficulty in communication often prevents adequate diagnosis of mentally handicapped children. Various diagnosticians have implied that by removing the language handicap of children, their intelligence quotient scores can be raised. Leberfeld (36) found that, "In an experiment with children enrolled in the Speech Clinic, it was noted that those who improved in language and speech as a result of therapy also improved correspondingly in measured mental ability." Jellinek (28), working with the language development of mentally retarded children, stated, "The cases quoted illustrate sufficiently our theory that abnormalities in intelligence, emotions and social behavior can be decidedly improved by meliorating the fundamental defects, similar to apraxia, agnosia, and aphasia, from which almost all of these persons suffer."

In accordance with the multi-causality principle of mental retardation, the language and speech handicaps of retarded children have to be properly diagnosed and analyzed. Psychologists such as Esquirol (16) were interested in speech and its development as a basis for differentiating mental defectives from normal individuals. Whether language disorders are etiological in nature or a part of the symptomatology that accompanies mental retardation is an important consideration in diagnosing and evaluating therapy for the mentally retarded. Schlanger (54), working with a select group of retarded brain-damaged children with delayed speech and/or speech and language disorders, stated, "Until the solution of the primary difficulty, viz., aphasic, psychic, mental capacity is realized, speech therapy has to continue to develop and maintain the child's awareness of speech."

Among institutionalized children, the possibility of reduced language and speech stimulation during the speech readiness age appears to be a major factor in the high incidence of speech disorders. Schlanger (55) developed a study which was designed to determine the influence of the environment on the speech of mentally retarded patients. He used mean sentence length and words per minute to measure language development. The results of this investigation indicated that institutionalized mentally retarded children used a mean sentence length of 4.18 words, compared to 5.36 words for mentally retarded children residing elsewhere. The non-institutionalized children also used more words per minute than did the institutionalized children. In a consideration of the reasons for these results, Schlanger indicated that:

> The effect produced by the severance of familial ties cannot be discounted. The emotional reactions produced by this traumatic act may result in some loss of security in interpersonal relationship which is expressed in minimal verbalization.

When speech and hearing therapy is considered for this population, it is evident that these conditions must be considered. Based on this realization, speech and hearing programs have been instituted in various training centers for the mentally retarded.

The present study was designed to evaluate a therapeutic technique especially adapted for mentally retarded institutionalized subjects. Considering the high incidence of speech defects found in the mentally retarded population, and the slow learning rates of these children, it is important that speech therapists have at their command techniques designed especially for these retardates. The experimental therapy has been based upon the theory of language development reported by Mowrer (47), (48).*

As background information related to the design of the experiment and particularly to the development of the experimental therapy technique utilized therein, the remainder of this chapter will be devoted to discussions of the following topics: incidence of speech problems, types of speech problems, intelligence related to onset of speech, speech development related to intelligence, hearing losses, normative data and sidetone study, feasibility of therapy for retardates and theoretical basis for the experimental therapy.

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* Discussions regarding the theory, the experimental therapy, and the experimental design were conducted with Dr. Mowrer prior to the investigation.

Incidence of Speech Problems

Various researchers in private and state schools for the mentally retarded have published data revealing the incidence of speech disorders found in their institutions. The fact that most of the studies containing statistics of the speech deficiencies of a mentally retarded population were conducted at institutions must be taken into consideration before generalizations regarding the incidence of speech disorders in the total population of the mentally retarded are discussed.

It has long been recognized that speech disorders of varying degrees of severity are manifested in the mentally retarded population. Whereas in early investigations speech disorders were reported in general terms, they are now listed according to some classification schema. A proper evaluation of the differences and similarities in statistical findings reported by different investigators must recognize the different tests and techniques of scoring used, the levels of comprehension evaluated, the differences in classification, age and sex of subjects, and the length of institutionalization of the patients.

In one of the earliest studies of the language of institutionalized mentally retarded patients, Town (71) investigated the speech of 285 children. Subdivided according to the Binet-Simon Scale (sic), there were 50 idiots, 90 low-grade imbeciles, 45 middle-grade imbeciles, and 100 high-grade imbeciles. This study revealed that 60 per cent of the low-grade imbeciles stammered (sic); 45 per cent of the middle-grade imbeciles stammered; and 48 per cent of the high-grade imbeciles stammered. Two other speech classifications were reported. In the low-grade imbecile sample, 3.3 per cent stuttered; of the middle-grade imbecile sample, 4 per cent stuttered; while 3 per cent of the high-grade imbecile subjects stuttered. Town's results pertaining to the incidence of stuttering were much lower than the statistics reported in a later study by Schlanger and Gottsleben (60). In the low-grade imbecile group Town found that 22 per cent had articulatory defects; in the middle-grade imbecile group 5 per cent had articulatory defects; and in the high-grade imbecile group, only 4 per cent had articulatory defects. Town's results relative to articulatory defects in these institutionalized subjects were much lower than the results published by other authors. In a 1930 Ph.D. dissertation which presented a detailed analysis of the speech of 249 institutionalized feeble-minded children who were grouped according to I.Q. levels, Kennedy (34) reported that 42.57 per cent had speech defects.

In 1932, Lewald (37) reported the results of a speech analysis of a group of 500 mental defectives. In the "language speaking" feeble-minded sample, 56 per cent had some type of speech defect. There was a larger percentage of speech disorders in the children under ten years of age than among the older patients. Although the results of the Lewald study did not include speech classification, the overall findings are in agreement with the incidence of articulatory defects discovered by other researchers. In an investigation of speech defects in the Newark State School, Sirkin and Lyons (66) found that of 2,522 mentally defective patients, 60 per cent had some type of speech defect. Sachs (52) investigated a population of mentally retarded individuals at the Lynchburg State Colony in Virginia who were between ten and twenty years of age. He examined 210 subjects from different I.Q. levels, and found speech defects in 57 per cent of the sample. In an analysis of this group, Sachs found that 21 per cent of this sample had a combination of articulatory and phonatory defects. Seven per cent of the sample had voice difficulties, and seven per cent also had unintelligible speech. Finally, nine-tenths of the sample had a rhythm defect. Sachs stated that:

> From results of this study, it can be seen that important questions remain unanswered and stand as questions for further study. They are: (1) what factors are responsible for the individual differences found among the respective psychological status with respect to speech? Or precisely, why is it that some imbeciles possess normal speech, while some borderline cases have defective speech? What effect does the etiological nature of the mental deficiency have upon speech? That is, endogenous and exogenous factors of mental deficiency have the same effect upon the speech pattern of the ament?

In one of the most comprehensive studies of the speech of institutionalized children, Schlanger and Gottsleben (60) reported their findings of the speech abnormalities in a group of patients at the Vineland Training School. Of this group, 400 subjects manifested some form of articulatory defect. Two hundred subjects, or 47 per cent, indicated some type of voice disorder, and 89 subjects, or 17 per cent of the sample, stuttered. When the subjects in this study were grouped etiologically, the greatest incidence of speech disorders was found in the "Mongoloid group." Within this group, 95 per cent had defective articulation, 72 per cent had voice defects, and 45 per cent had symptoms of stuttering. The next highest group on the etiological scale was the "Organics." Within this group, 84 per cent had defective articulation, 56 per cent had voice defects, and 18 per cent had symptoms of stuttering. In the "Undifferentiated" group which followed, 80 per cent had articulatory defects, 45 per cent evinced voice defects, and 13 per cent stuttered. Of the four largest etiological groups studied, the "Familial" group revealed the least defective speech. Articulatory errors were found in 69 per cent of this group. A total of 22 per cent had voice defects and 10 per cent stuttered. A summary of the studies discussed in this section may be found in Table 1.

Whatever the cause of speech disorders, whether it be due to depressed environmental stimulation during childhood, emotional disorder, brain damage, or institutional living, it is obvious after reviewing the literature that speech disorders are prominent in institutionalized mentally retarded children, and speech disorders are not restricted to one etiological group.

Table 1

Table of General Incidence of Speech Defects Found in Mentally Retarded Patients as Reported by Various Investigators

Study	Type of Subjects	Number of Subjects	Incidence of Speech Defects (Percentage)
Kennedy (1930)	Institutionalized Population	313	
	Idiots	32	100
	Imbeciles	32	71.87
	Morons	249	42.6
Lewald (1932)	Institutionalized Population	500	
	(Language Speaking)	Not Given	56
Sachs (1951)	Institutionalized Population	210	57
	Borderline		18
	Moron		44
	Imbecile		79
Schlanger (1953)	Institutionalized Children	74	68
Schlanger and Gottsleben (1957)	Institutionalized Population	516	79
Sirkin and Lyons (1942)	Institutionalized Population	2522	60

Types of Speech Difficulties

Although speech disorders of institutionalized children are not limited to any one type of speech classification, articulation error is the most frequent type of speech defect, and it is usually reported by all investigators.

Bangs (2) reported an articulatory analysis of the speech of mentally retarded children. He found that the most common articulatory error was the omission of sounds, especially in the final position. The voiceless th in all positions was the sound that was "avoided" most by the children in his study; the most frequent single substitution /f/ for /θ/ (voiceless th). Bangs found that the type of voiceless substitution used by his experimental subjects was similar to those substitutions of normal children. In conclusion, he stated that, "The speech of primary aments tends to correspond very closely to that of normal children with comparable mental age in so far as preferred sounds, sounds avoided, and most frequent substitutions are concerned." He further concluded, "Aside from more frequent omission of final sounds, the articulatory speech defects of the primary aments do not differ qualitatively to any marked degree from the defects which might be found in children whose intelligence falls within the normal range."

In a study of language development of normal children, Templin (68) noted the types of error found at different age levels. Templin found that, "For the sample as a whole, substitution errors were approximately ten times as frequent as omissions, and about four and one half times as frequent as the use of defective sounds. She also stated that, "...omission errors decrease with age, from 13.3 per cent of the errors at three years to only 2.2 per cent at eight years." These results are in agreement with the results reported by Bangs (2).

Schlanger (57), Sachs (52) and Kennedy (34) reported that articulatory defects were the most frequently found errors in their samples. In order of prevalence, most researchers indicate that articulatory defects are followed by voice and rhythmic disorders respectively.

There have been a number of studies which have described the speech characteristics of a particular type of etiologically classified group of mentally retarded children. The following studies are typical of such investigations.

In the Kennedy study (34), seven subjects were mongoloids. Kennedy reported that:

> The speech of these seven subjects is markedly similar, showing dyslalia, dysphonia, and dysarthria. More specifically, their speech is characterized by megaphonia, pharyngophonia, monotonous sentence pattern and baylalia.

Gottsleben (22) found that there was a significantly greater incidence of stuttering which occurs in a mongoloid group than that which occurs in a group of non-mongoloid mentally retarded individuals. However, this greater incidence for the mongoloids was equal to that reported by Schlanger and Gottsleben (60), who investigated the entire population of mentally retarded subjects at the Vineland Training School. Gottsleben (22) also found that there was a higher incidence of stuttering in mongoloids than among the normal population and a higher incidence of stutterers among male mongoloids than among females. Gottsleben stated that, "A definite relationship is indicated in this specific, limited population between the factors of mongolism and stuttering." Voelker (75) reported an interesting sidelight on spasmophemia and its nature. He stated that the only case of stuttering reported at the Ohio State Institution for the Feebleminded was a mongolian boy. He concluded that, "I have also had the opportunity to see primary and secondary spasmophemia in both sexes of mongolians."

Benda (4), in a book which describes mongolism and cretanism, suggests that he could diagnose the case by listening to the voice of the mongolian child. He does not identify the stuttering patterns that other investigators found, but he describes the unique vocal and articulatory disorders of this group. Benda states that, "The voice is raucous and of a low pitch, almost masculine, which is in striking contrast to the infantile appearance of these patients." In addition to voice disorders in this population which Benda believes could be traced to some type of pathological condition of the vocal folds and resonators, he finds that mongoloids have articulatory difficulties.

Cabanas (11), although noting that mongolian children often block on sounds, repeat words and hesitate, wrote that there are psychological differences between the blocks of the mongolian child and those of the stammerer. He stated that, in contrast to the true stutterer, the mongolian child does not anticipate blocks, does not use avoidances, has no "Jonah" words, does not appear aware of the situation of blocking, and does not block consistently on the same sounds. Cabanas concluded that the speech of the mongolian is more of the cluttering type with three main symptoms: lack of vocabulary, quick speech, and "lack of idio-motor equilibrium."

Meader (43) concluded that the most frequently found error in a mentally retarded institutionalized population was "hyphoid speech." This special type of speech disorder is closely associated with a general retarded development usually found in this population. Gens (19) investigated the speech production of epileptics and found that there was no evidence of the "plateau speech" that other investigators had reported in their findings.

The speech of the cretins has been analyzed by several authors. Schrieber, Bronstein and Brown (65), made a careful analysis of the speech of cretin children. They found that the greatest number of errors (except for omissions) were made in the initial position; the most frequently omitted sound was the /t/ in the medial position. These authors also found that:

> Prolongations, a peculiarity of this group which occurred chiefly in the initial position, involved both consonants and vowels, but only the latter were prolonged in the middle position, accounting for drawling speech. Of the involved consonants, /n/ was most commonly prolonged.

In discussing the cretin child, Benda (4) states:

> The untreated cretin will not learn to speak. He will utter some indistinct sounds in a low-pitched, harsh voice. The thick lips and the heavy tongue make even the treated cretin sound tongue-tied and muttering like a drunkard.

Table 2 presents a summary of the type of speech defect found in the mentally retarded population.

In summary, there have been no studies that have been able to assign any special speech phenomenology to the mentally retarded population. The outstanding type of speech error appears to be articulatory, characterized by omissions of sounds. Some researchers have investigated the speech of special etiological groups. The speech syndrome of the mongoloid and the cretin appears closely associated in etiology with the physical aspects of the disorder.

Intelligence Related to Onset of Speech

Delayed speech has been offered as a possible index of mental retardation. Tredgold (73) believes that if a child fails to develop speech by the time he is four years of age, this factor becomes important in the diagnosis of mental retardation. Meader (43) had recognized a pattern of delayed speech called "hyphoid speech" which is closely associated with retarded men-

Table 2

Types and Frequency of Speech Defects Found in Mentally Retarded Populations

Study	Type of Subject	Number of Subjects	Types of Defects (Authors' Terms)	Incidence (per cent)
Kennedy (1933)	Institutionalized Population	313		
	Imbeciles	32	Dyslalia	92
			Dysphonia	56
			Dysrhythmia	36
	Morons	249	Hoarseness	14
			Idiophonia Path.	10
			Nasality	13
			Oral Inactivity	13
			Rhotacism	6
			Sigmatism	8
			Stuttering	2.8
Sachs (1951)	Institutionalized Population	210		
			Articulation	21
			Artic. and Phonat.	20
			Phonation	7
			Rhythm	0.9
			Unintelligible	7
Schlanger (1957)	Institutionalized Children	74		
			Artic. Problems	62.1
			Cerebral Palsy	5.4
			Cleft Palate	1.4
			Stuttering	20.3
Schlanger & Gottsleben (1957)	Institutionalized Population	516		
			Articulation	78
			Stuttering	17
			Voice Disorders	47
	Mongoloids			
			Articulation	95
			Voice Defects	72
			Stuttering	45

Table 2 (cont'd)

Study	Type of Subject	Number of Subjects	Types of Defects (Author's Terms)	Incidence (per cent)
	Organics		Articulation	84
			Voice Defects	56
			Stuttering	18
	Undifferentiated		Articulation	80
			Voice Defects	45
			Stuttering	13
	Familial		Articulation	69
			Voice Defects	22
			Stuttering	10

tal and physical development. In hyphoid speech, Meader stated, "All the speech levels are affected: melody, rhythm, accent and phonation, as well as articulation and rhythmic integration of syllables in sequence." West (78) states that only when a child is at the level of the low grade idiot can the complete failure of speech be caused by the mental deficiency. Kastein (33) believed that a low I.Q. in itself should not necessarily be considered the cause of slow speech development. In an article describing speech of the mentally retarded, Goertzen (20) stated that, "This brings one to the practical point of saying that whether or not low mentality causes the delayed development and/or defects of speech and language, these do co-exist in sufficient ratio among mentally retarded children to be of considerable concern." In an intensive study (1) of 1,000 children referred for a variety of problems to the Institute for Juvenile Research in Chicago, a careful analysis of speech acquisition and intelligence was made. There was a range of I.Q. from 10 to 159 as measured by the Stanford-Binet test. The average intelligence quotient for the boys was 80, and for the girls 82. Arrayed with these data were age levels at which the children acquired language. Coefficients of correlation were calculated and the authors concluded, "In view of the low probable error, the correlations are quite reliable and may be interpreted to mean that there is a definite relationship between these two factors." They also stated that:

> ...the higher the intelligence quotient (that is, the more intelligent the child) the earlier it learns to talk.
> ...as the intelligence quotient increases, the age in months at which a child first talks decreases.

Irwin and Chen (26) completed a study of the development of speech sounds and intelligence. The Kuhlmann Test of Mental Development and two forms of a speech index were utilized in this study. The authors stated that, "The foregoing analysis suggests that speech sound development for the first two years of life is independent of intelligence test scores." This same principle was expressed by Meader (43) when she stated that, "The acquisition of phonetic speech is relatively independent of I.Q.; only with the complex development of vocabulary and syntax does 'intelligence' become a major factor." In summary, it appears that although there is some agreement among authors concerning development of speech and level of intelligence quotients, other factors must be examined before delayed speech development can be directly associated to a low intelligence quotient. Nonetheless, there is little disagreement with the generalization to be found in such authoritative textbooks in the field of speech pathology as those of Van Riper (74) and Berry and Eisenson (5) that one possible cause of delayed speech is mental retardation.

Speech Development Related to Intelligence

Considering the high incidence and severity of speech defects in the mentally retarded population, researchers have attempted to correlate intelligence quotients with speech ability. In a study of the speech of cretins, researchers (65) found that for this population, "The relation of age and I.Q. to the various errors discussed under omissions, substitutions, approximation, prolongation, showed that most of these occurred in the lower age and I.Q. level."

Kennedy (34) described an analysis of the speech of three groups of mentally retarded, institutionalized children. There was a "high-grade" group of children with I.Q.'s ranging from 50 to 69; a "middle-grade" group with I.Q.'s ranging from 21 to 47, and a "low-grade" group with an I.Q. range of 20 to below any testing level. For the low-grade group, Kennedy concluded, "Idiots have no speech." In the middle-grade group, she found

that 71.87 per cent of the population had dyslalia, while in the upper-functioning group, Kennedy found:

4. **that speech defects in the moron group are:**
    - **(a) more numerous and more severe than in the normal group**
    - **(b) more numerous and more severe among males than among females**
    - **(c) more prevalent among the younger members of the population studied**
    - **(d) more prevalent among (1) those who have a history of disease or injury; (2) those who are inferior in respect to intelligence quotient; (3) those who are inferior in respect to educational quotient; and (4) those who are inferior in respect to performance quotient.**
5. **that these items 4 (d) are arranged above in the order of their effectiveness as factors etiological in speech disorders.**

A study was conducted to investigate the speech and sound development in a mentally retarded population. In this study, Irwin (27) measured the speech of ten "low-grade feeble minded cases, idiots and imbeciles." The I.Q. range of these children was from 7 to 48. Utilizing speech indices as a measure, Irwin found delayed speech development to be characteristic of these institutionalized children. He stated that, "The ratio of vowels to consonants in the speech sounds of this group of feebleminded children is 1, whereas that of mature speech is 1 to 2. None of the ten subjects exhibits the mature ratio." In addition, he found that, "Feebleminded children use back vowels more infrequently than front vowels." He also studied the speech of a group of four-year-old children in the institution, and he found

that their speech sound development was similar to the speech of normal children "less than one year of age."

In a Master's thesis concerned with the relations of speech to mental deficiency, Sachs (51) found, "Eighteen per cent of the borderline cases examined were found to be defective in speech while forty-four per cent of the moron and imbecile group respectively were diagnosed as having speech disorders."

Bangs (2), in his investigation of the articulation of the mentally retarded, found that there was some correlation between speech ability and chronological age. A significant finding in the Bangs study was, "The relationship between speech proficiency and mental age was found to be greater than that which existed between intelligence quotient and speech proficiency, and this indicates that the mental age of the ament is much more significant as a determining factor in his speech than is his intelligence quotient." Bangs, as a result of this finding stated, "We may infer from this that the most significant factor in predicting the speech of an individual will be his mental age."

In an investigation of the development of speech sounds in children, Irwin and Chen (26) found that, "From an examination of these correlations it appears to be a reasonable generalization that there is a moderate degree of positive relationship between mental age and the two indices of speech sound development."

Brandfon (9) reported on the speech of mentally retarded children in a classroom situation and found that, "Language facility in general varied with the degree of the amentia."

In a detailed analysis of children of low I.Q. levels, Karlin and Strazzulla (31) found that maturation develops slowly in this group. The I.Q. range of the children in this study was from 15 to 70 as measured by the Stanford-Binet form L and the Kuhlmann Tests of Mental Development. The authors found some children in the lowest I.Q. group with good articulation. They indicated that this may be due to the limited vocabulary which reduced the chance of making articulation errors, or to echolalic behavior of these children. Besides the speech defects found in this sample, the investigators also found; "In addition to the lack of abstract thinking, irrelevancy of ideas, echolalia, and tendency to perseverate, many of the children also showed a poor attention span, an easy distractability and fatiguability."

In a study of idiopathic language retardation, Goldenberg (21) found that further testing of 14 children who had been labeled as idiopathic language retardates, revealed that the delayed speech development was due to severe mental retardation. After testing an institutionalized population, Schlanger(56) divided the speech and language abilities into three arbitrary groupings and characterized them according to oral abilities. The following are the language categories:

a. Group 1 - Expressive language is rudimentary with a complete or partial lack of verbal response. If there is oral responsiveness, this does not go beyond the utilization of undifferentiated gestures and/or one-word sentences.

b. Group 2 -- Verbal output is limited and consists of short, incomplete sentences and phrases. Sentences are two to three words long, simple, with later developing sentence parts such as prepositions, relative pronouns, adverbs, adjectives omitted.

c. Group 3 - Full sentence usage with verbal output consisting of sentences of four or more words. Sentences may be simple or complex but they express complete thoughts or ideas.

Schlanger found that the familial group had the highest percentage of individuals who met the requirements of Group 3. With the exception of the mongoloid population where a majority of the children were classified in Group 2, most of the children in the four major etiological classifications were scored as belonging to Group 3. He found that in this institutionalized sample, the familial group was most like the normal population and the mongoloid group exhibited the least well-developed speech. Schlanger concluded, "It would seem to apply in language, as well as in speech, that while delays and defects in language vary with levels of intelligence, one should not assume that a talkative child is necessarily a normally intelligent one."

Although most of the published research has concluded that there is some correlation between speech development and intelligence, no study has proved conclusively that this correlation is of even moderate magnitude. Kastein (33) reported:

> The intelligence quotient of a child is not directly related to language development. Thus, a child with good intelligence may have absent or defective speech, whereas

> a child with an intelligence quotient as low as 40 may have surprisingly good speech. The low I.Q. itself is not necessarily the cause of lack of speech development.

In a study of the language development of normal preschool children, McCarthy (42) states, "We can hardly say that the more precocious linguistic development of the girls is due to a more precocious intellectual development as evidenced by the higher I.Q.'s of the girls, but rather it is more likely that the higher intelligence test scores obtained by them are due to their more precocious linguistic development." McCarthy continues her discussion of the development of language processes by stating, "This rapid development in such an intricate and distinctly intellectual function is indeed remarkable when we realize that it occurs in individuals who are decidedly immature physically, and who have mental ages of only two, three, and four years."

In summary, there appears to be a sufficiently low correlation between speech development and intelligence quotient to conclude that factors other than a low intelligence score may help to account for the high incidence of speech defects in an institutionalized mentally retarded population. The same factors that account for the apparent lack of speech development may be responsible for the depression of the intelligence quotient. Many of the reported tests utilized the Stanford-Binet for the measurement of the I.Q. levels. A study aimed at correlating performance I.Q.'s and verbal I.Q.'s with speech sound production may help to clarify this confusing picture.

Hearing Loss

There have been a number of investigations involving the auditory acuity of mentally retarded samples. Considering the unusual incidence of respiratory disorders and other pathological states that are found in the mentally retarded population, research has been conducted to determine the incidence and type of hearing loss manifested by such subjects. In one of the first major studies of the hearing acuity of mentally retarded children, Birch and Matthews (7) tested the hearing of 247 of such institutionalized children. The subjects in this study were between the ages of 10 and 39 and had mental ages of five years or more. Utilizing a screening technique they found, "There is a significantly larger proportion of hearing loss among institutionalized mental defectives in the age range from [illegible] to [illegible] years than in the non-defective population available for comparison." An interesting aspect of this report was the predictive factor that was determined for reliability of the hearing tests. In the M.A. range group between 4-1 and 5-0, the authors found that almost every two out of three subjects successfully passed an audiometric examination. They also found that a reliable audiometric test could be obtained for subjects in the M.A. range from 5-1 to 6-0. Of the sample studied, 32.7 per cent were severely impaired auditorily. The authors found that

> It is evident that the percentage differences...indicate 2½ to 18 times as much hearing loss in the population of mental retardates, depending upon the frequency compared. These percentages differences are significant at the 1 per cent level.

Reporting this high incidence of hearing loss, the investigators stated that when diagnosis of mental retardation is being made, the hearing loss must be considered.

MacPherson (40) in a questionnaire study found that most of the mentally retarded institutionalized children manifesting hearing losses are either deaf or severely hard of hearing. As an implication for therapy, MacPherson stated, "Between 19.2 per cent and 24.01 per cent of the deaf and/or hard of hearing mentally deficient in institutions for the mentally deficient have been reported as being of school age."

Johnson and Farrell (30) measured the hearing acuity of 270 children at the Fernald State School. These tests covered the frequency range from 250 cps through 6000 cps. They found that 24 per cent of this group showed significant impairment of hearing, A comparison of the hearing of children in the Massachusetts public school system with the hearing of children at the Fernald School indicated that the incidence in the latter institution was five times that of the public school subjects. The authors also found a higher incidence of hearing loss in the male residents of the institution than in the male sample taken from the public schools. The hearing losses at the Fernald School were also of a more serious type than those found in the public school system. As a result of the incidence of hearing loss in this sample, in which about 64 per cent of the children had bilateral auditory loss, a therapy program (29) was designed for the group. The medial intelligence quotient for this group was 54.5, as measured by the Stanford-Binet, Arthur Performance Scale, the Porteus Maze Test and the Goodenough Draw-a-Man Test. After therapy was completed, the authors found a significant improvement in the speech reception threshold of the subjects. Comparing the experimental group with the control group, they found that speech production had not improved, nor had any of the retarded group attained higher academic achievement.

In a study of 74 children enrolled at the St. Colletta's School for the Mentally Retarded, Schlanger (57) found that approximately 30 per cent of the group suffered from auditory impairments, with 14 per cent of the children having severe hearing loss as defined by the American Medical Association.

Utilizing the techniques of Birch and Matthews (7), Foale and Patterson (17) conducted a study of institutionalized male patients at the Lennox Castle Institution for Mental Defectives located in Scotland, and found that 33 per cent of the sample had deficient auditory acuity.

Testing 498 residents at the Vineland School, Schlanger and Gottsleben (62) utilized different audiometric techniques especially adapted for a mentally retarded population. The test included frequencies from 125 cps to 12,000 cps. The modifications made were a longer training period at 50 db for 250, 1000, and 3000 cps, and an "ear-choice" technique. Bone conduction testing was also utilized. Of the 498 children tested, about 35 per cent had normal hearing, 14 per cent were impaired slightly at the extreme frequencies, 28 per cent were in the moderate loss category, and 6 per cent of the subjects were hard of hearing. Hard of hearing as defined in this study was, "Losses in both ears greater than 30 db but with residual hearing. Interferences with the hearing of speech." Deafness in one or both ears was found in 1 per cent of the sample. The criterion used for deafness was, "No response in affected ear(s) at any frequency at maximum output of audiometer." There was greater hearing loss present in the population with a C.A. of 20 or more than in the lower C.A. group. A total of 17 per cent of the population was classified as "non-testable." Schlanger and Gottsleben stated:

> These children usually were below a mental age of five years, had personality disturbances of varying degrees, and social quotients below 40. Four-fifths of this group were of either organic or mongoloid etiology.

In this study, the authors stated that the younger children who did not respond to standard audiometric testing may have responded to psycho-galvanic testing. They also indicated, "However, there was a high incidence of cerebral insult in this group of young retardates which might have affected PGSR audiometry results."

A group of researchers (25) attempted to apply psycho-galvanic testing to 20 mental retardates ranging from 9 to 38 years of age. Sixteen of these subjects were chosen for the experiment because of possible hearing loss. Four of the children suspected of having hearing loss were classified as mongolian. Psycho-galvanic testing was employed for the frequencies 100, 500, and 4000 cps. After this testing was completed, an attempt was made to obtain audiometric threshold by utilizing the traditional voluntary response techniques. The investigators found that they were able to achieve conditioning in a sample of subjects with low I.Q.'s. The authors stated, "We believe our most significant result is the demonstration of essentially normal conditional GSR's in the major portion of a group of individuals of low I.Q."

There have been other studies which were designed to measure differences in the response of mentally retarded subjects to pure tone testing. Using the alternate ear technique or standard audiometric technique, Bradley, Evans and Worthington (8) attempted to determine whether or not there was a relationship between I.Q. and time required to obtain threshold measurements. In this study, 60 children between the ages of 7 and 13 with an I.Q. range from 30 to 70, were administered hearing tests. The children were put into two groups: a middle group with an I.Q. range between 30 and 50, and a high-grade group with an I.Q. range between 50 and 70. Using the alternate ear technique, the authors found that in the high-grade group 43 per cent had hearing loss, while in the middle group 47 per cent showed impairment. When the standard hearing tests were given, 30 per cent of the high group demonstrated reduced acuity and in the middle group, 33 per cent of the subjects had hearing loss. In this study, "A loss greater than 20 decibels for two frequencies was considered as a significant loss." The authors concluded that the mental ages and intelligence quotients of the subjects were related to the time required to test the subjects, and that more rapid testing was accomplished with standard audiometric techniques than was achieved with the alternate ear technique.

Table 3 contains a summary of the incidence of hearing loss as reported by various studies.

The review of the literature has revealed that there is a high incidence of hearing loss found in mentally retarded subjects. This fact must be considered in the diagnosis of the mentally retarded regardless of the etiological classification, and in the planning of academic and/or vocational programs for this population. Further research into the

Table 3

Summary of Studies Reporting Hearing
Loss in Mentally Retarded Individuals

Investigator	Subjects	Technique Used	Number	Incidence of Hearing Loss (Percentages)
Birch and Matthews (1951)	Institutionalized Children & Adults	Pure Tone Screening	247	32.7 Severe 50 Some
MacPherson (1952)	Institutionalized Children	Questionnaire Sent to Institutions		50 Severe
Johnson and Farrell (1954)	Institutionalized Children		270	24 greater than 20 db.
Schlanger (1953)	Institutionalized Children		74	30 Some 14 Severe
Foale and Patterson	Institutionalized Male Patients	Pure Tone Screening	100	33 Some 13 Severe
Bradley, Evans & Worthington (1955)	Institutionalized Children	Alternate Ear	60	
	High Group			43
	Middle Group			47
		Standard		
	High Group			30
	Middle Group			33
Schlanger and Gottsleben (1957)	Institutionalized Children & Adults	Various kinds of Audiometric Techniques	498	14 Slight 28 Moderate 6 Hard of Hearing

etiology of hearing loss found in mental retardates is needed, as well as research to determine the types of hearing losses prevalent in this population. In addition, research is needed to develop preventive techniques, and to evaluate the success of medical treatment.

Normative Data and Sidetone Study

There have been two studies, one a Ph.D. dissertation (14) and the other a Master's thesis (3), completed at the Purdue University Speech and Hearing Clinic, which have indicated normative data for voice variables of institutionalized mentally retarded patients.

Drexler, in a Ph.D. dissertation, (14) studied the voice variables of 49 institutionalized, mentally retarded adults. Arranged in categories according to age, the subjects were classified by I.Q. and sex. For subjects in the 40 to 60 years age group, Drexler found that the mean pitch level, pitch variability, the phonation time ratio, and the mean speaking rate for a single utterance were within the range of scores reported for normal adults. Drexler stated, "The voice variables which appear to differentiate the adult mental retardate from the adult normal speaker are phonation time ratio and overall speaking rate."

Barnes (3) reported the results of using delayed sidetone with mentally retarded adults. Twenty mentally retarded adults were placed into either a high or a low group, depending upon I.Q. score. As the subjects were describing pictures shown by the experimenter, conditions of delay were presented to them through earphones. The sidetone delay times used were: .15, .25, and .35 seconds. For phonation time/ratio and for relative average speech power, Barnes found that there was a statistical difference between conditions of delayed sidetone as compared with conditions of no delay. He reported no differences in the speaking rate of his subjects under conditions of delay. Both Barnes and Drexler found that their subjects spoke at slower rates than did normal subjects.

The investigations of Barnes and Drexler are of value to the therapist planning speech programs insofar as they reflect the speech modifiability of mentally retarded individuals. Furthermore, these studies suggest that mentally retarded individuals may react to certain speech stimuli in a manner similar to normal subjects.

Feasibility of Therapy for Retardates

Various opinions have been expressed about the feasibility of providing speech therapy for mental retardates. Within recent years there have been a number of studies which have described the rationale for such speech therapy and there also have been a number of studies employing speech therapy.

Bibey (6) believed that speech therapy could be justified for the mentally retarded. She stated that:

> (1) Every individual should possess the human dignity and self-respect which can only be attained through optimal functioning of his native capacities; (2) The research in speech problems which can be carried on most efficiently in an institution for mentally deficient children may be of benefit not only to the immediate child but to all children and adults; (3) The prevention of misdiagnosis necessitates the interaction of the speech profession with all other professions involved in the diagnosis of the mentally deficient child.

The first reason listed above by Bibey is the usual rationale offered to justify speech therapy for most speech defectives. Her second statement obviously is a very important reason for providing therapy to the mental retardate. The third rationale suggests the potential utilization of therapy as an aid to diagnosis.

Another rationale cited for offering speech therapy to the mentally retarded is the possibility that therapy may help to raise intelligence quotients. Leberfeld (36) stated, "In an experiment conducted with children enrolled in the Speech Clinic, it was noted that those who improved in language and speech as a result of therapy also improved correspondingly in measured mental ability." Leberfeld indicated that speech therapy for the mentally retarded should be instituted as soon as possible and I.Q. scores or the M.A. should not be the sole criterion for beginning speech therapy. In contrast to this last opinion, Sirkin and Lyons (66) stated, "The chief factors for favorable prognosis were found to be: At least moron intelligence, cooperation, a mental age of at least 5 or 6 years, the presence of defects which are not physically too severe."

Although Weiss (77) realized that difficulty may be encountered when administering therapy to the mentally retarded, nevertheless he indicated that, "....treatment may have a much more profound influence on the mental development of the patient, and therefore, constitute a decisive factor for his future."

Schlanger (58) believes that speech therapy should be provided for mental retardates. He offers the opinion that the mentally retarded child should be given every opportunity to develop to his capacity, and that speech therapy can be used to study and modify the child's behavior.

In contrast to these opinions, there have been some authorities who doubted the value of administrating speech therapy to the mentally retarded child. Louttit (38) feels, "Consistant training of mentally low-grade children may result in some improvement, but there is a serious question whether the results justify the effort required." Sirkin and Lyons (66) listed criteria for the application of speech therapy to the mentally retarded, stating, "In general it has been our experience that correction of patients below the moron grade is unsuccessful, and that a minimum age of five or six years is essential." West (78), describing the speech characteristics and therapy for mongoloid children, believes that these children usually do not benefit from speech therapy. He feels that when therapy is attempted with the mongoloid, it should be understood that the therapy will be experimental, and the results will be limited. Matthews (41) adds some clarification to this controversy when he states that, "Perhaps the pessimism about the success of speech therapy with the mentally retarded is based to a large extent in the failure to apply to the retarded therapy procedures suited to their needs and capacities."

Procedure and Evaluation of Therapy

Several speech therapy procedures have been applied to mentally retarded children. Weiss (77) stated, "This will require the usual therapy, and here we wish to emphasize the necessity of proceeding in the so-much decried 'synthetic' way." In this technique sounds are pronounced, then presented in nonsense syllables. He believed that although this technique is slower, the mentally retarded child will not be confused by an attempt to use an analytical method of deriving sound elements from complete words. In discussing artículation therapy Weiss stated, "Here the usual methods of therapy will have to be applied." He further stated, "There is, however, one specific observation to be made: in the treatment of dyslalia we often turn to intermediary phases in the development of certain consonants (e.g. st before developing s, etc.); retarded children may get 'stuck' at such intermediary articulation and, therefore such intermediary phrases should be avoided as far as possible."

In a discussion of the speech habilitation of a post-encephalitic retarded child, Kastein (32) stated:

> The therapeutic approach was global and the goal manifold with psychological, perceptual and conceptual (linguistic) objectives. Specifically the objectives comprised the training of (1) symbol behavior, (2) longer attention span, (3) visuo-motor coordination, (4) functions of the muscles of articulation, (5) determination and establishment of laterality and (6) parent guidance.

Schneider and Vallen (63) described therapeutic techniques that were apparently effective with mentally retarded children. In their technique, emphasis was primarily on language development and secondarily on articulation defects. In articulation therapy these authors stressed ear training, phonetic placement, and integration of sounds in words and sentences.

Lubman (39) also reported on a technique of speech therapy. Essentially this technique utilized auditory and visual stimulation. A single lesson consisted of practice with nonsense syllables, word stimulation (using objects and pictures), and concluded with practice in extemporaneous speech.

Schlanger (58), (61), (54) has published a series of articles describing speech therapy for the mentally retarded. He believed that articulation therapy should be initiated only after a speech stimulation program is presented to make children more responsive to speech and to encourage speech production. In articulation therapy, he advocated a multisensory approach using different kinds of activities during each session.

Leberfeld and Nertz (35) outlined a home program in language and speech for the mentally retarded child. In this program parents were encouraged to stimulate children through games, records, and family activities. Specific sound therapy was postponed until professional help was available.

Matthews (41) suggests that for speech therapy to be successful, the programs should be geared to the mental age of the children. He doubts the value of rote memory drill, and he believes that the best results would come from speech stimulation techniques that have been used in the lower grades.

Some studies have been designed to evaluate the results of speech therapy administered to mentally retarded individuals. Schneider and Vallon (64) instituted intense speech therapy for mentally retarded children for one year. The results of the program were evaluated both subjectively and objectively. Improvement was noted for language development and articulation ability. As a result of articulation therapy the authors stated, "It may be concluded therefrom that neither the degree to which a sound was found to be defective nor the degree of difficulty inherent in its production showed any appreciable influence in the degree of progress achieved." When the experimenters judged the results of therapy subjectively they found that, "With greater facility in verbal expression seemed to come a reduction in anxiety producing situations, which in turn led to a reduction in asocial behavior, and has thus in many instances made for a happier and better adjusted individual."

Sirkin and Lyons (66) evaluated the results of a speech therapy program administered to 169 selected institutionalized children. In this group there were 19 borderline cases, 104 morons, and 46 imbeciles. The experimenters reported that in 87 cases there had been satisfactory results in speech therapy. Of this total, 70 children were considered to be corrected and the remaining 17 were still being treated. Of the 169 children in this sample, 73 were dropped from therapy "as not being corrected." Satisfactory results were achieved by 79 per cent of the borderline group, 26 per cent of the imbecile group, and 59 per cent of the moron group. Of 44 cases retaining correction, 30 had retained the correction for a period of over three years. The I.Q.'s of these 30 children ranged from 43 upwards, and only 8 of the subjects had I.Q.'s below 50. The authors concluded that one of the most important factors for the selection of cases for therapy is the manner in which the child cooperates.

Schlanger (58) instituted therapy for 62 speech defective children who had I.Q.'s from 39 to 77, with a mean M.A. of seven years, two months. The children were classified as to etiology and speech difficulty. Although retesting indicated that there was improvement in imitative speech, the speech improvement manifested by the children on the imitative tests would not have been as noticeable if tests measuring conversational speech had been used. He also found that after therapy the children were beginning to correct their own speech. Summarizing, he stated:

> In general, after one school year of speech therapy most of the children talk more and better in speech class but content remains impoverished. It is not expected that the latter will improve greatly. Sporadic errors continue in conversation but are less consistent. Without continued effort by trained personnel interested in the problems of the slow learner, there will be regression.

In another experiment, Schlanger (54) worked with twelve children who had severely retarded speech and language development. The chronological age of the group was between 4.8 and 9.8 years, the mean M.A. was 3.6 years, and the mean I.Q. was 41. He reported improvement in 9 of the 12 children in the study. For the other three children, Schlanger indicated, "Nevertheless these three, as well as the other subjects, improved to the extent that communication responsiveness was less restricted."

In Luhman's (39) program for severely retarded children, it was found that parents, teachers and the researcher agreed that 62 of the 85 children who had been given therapy had made progress. These results were confirmed by testing. Luhman found that the children who had shown improvement in speech had added at least 2 sounds to their speech production.

Mecham (45) constructed a program which was designed to measure objectively the results of speech therapy applied to mentally retarded institutionalized children. There were 21 children in the experimental group, ranging in I.Q. from 41 to 75, with a chronological age range of from 9 to 18 years. There was also a control group of 10 children, ranging in I.Q. from 55 to 81, and in chronological age from 9 to 15 years. As a check on the "....stability of the testing procedures and equipment," a third group was included in the program. This group consisted of 10 children who matched the other groups in I.Q. and chronological age. The experimental group received 8 weeks of individual and group speech therapy administered by 2 speech therapists. The controls received no speech therapy. Tests were administered which measured articulation, auditory discrimination, auditory memory span, and average sentence length. As a result of therapy, the experimental group showed significant improvement for articulation, auditory discrimination, auditory memory span, and a significant increase in sentence length. The control group showed significant improvement in only the auditory memory span test.

In a study evaluating the effectiveness of drug therapy on the speech of the mentally retarded, the authors (44) found that the drug (Tolseral) was not effective alone but it may prove useful as a relaxer in conjunction with therapy.

Table 4 is a summary of the experiments just described, in which evaluations of effects of speech therapy were presented.

The limited literature devoted to speech therapy for the mentally retarded is, in general, optimistic about the effects of such therapy. Most therapists who agree that speech therapy should be offered to this population feel that with greater language facility the children can function more efficiently in their environment, either the institution or the home. The fact that a speech defect may not be directly associated etiologically with mental retardation is another source of encouragement for those considering therapy for the mental retardate.

Although there has been subjective agreement and some objective verification that speech therapy has proved successful with mentally retarded children, there are no completed studies which evaluate the relative effectiveness of different techniques as contrasted to the control situation in which no therapy is administered. In the present study, two different articulatory training techniques will be compared and their effectiveness tested against two control conditions.

Theoretical Basis for the Experimental Therapy

As a result of detailed observations of the development of speech in "talking birds," Mowrer (47) formulated the "Autistic Theory of Language Learning." Rejecting other

Table 4

Summary of Results Obtained From Speech Therapy with Mentally Retarded Children

Investigator	Population	Number	Length of Therapy	Results of Therapy (Investigators' Report)
Sirkin and Lyons (1941)	Institutionalized Children	169	3½ years	70 cases made satisfactory improvement in speech. 17 still receiving therapy; 70 cases dropped from therapy.
Schlanger (1957)	Institutionalized Children	62	1 school year	Improvement in imitative speech.
Lubman (1955)	Children in Special Classes	93 85 tested	6 months	62 showed progress confirmed by testing.
Mecham (1955)	Institutionalized Children	41	8 weeks	Subjects receiving therapy made statistical improvement in articulation, auditory discrimination and auditory memory span.
Schlanger (1956)	Institutionalized Children	12		Improvement in 9 of the 12 children
Schneider and Vallon (1955)	Institutionalized Children		1 year	Improvement was noted for language and articulation ability

learning theories which attempted to explain language learning, he broadened the scope of his theory and applied it to the language learning of human infants.

Mowrer, while attempting to teach a bird to talk, discovered that the most effective method was for a "trainer" to feed the bird by hand and to say a word at the same moment that food was being presented to the animals. He believes (48) that the first essential step in this procedure is to treat the bird as a "good mother" treats a child, that is (48), "While caring for their infants or just spending leisure time with them, these mothers vocalized almost continuously;..." The bird should therefore be isolated and cared for by the "trainer" in order that "...the bird, as a result of developing 'positive cathexis' (love) for its human trainer, or 'foster parent' identifies with and tries to be like that person."

By saying words at the same time food and drink is offered, it is possible that (47) "This procedure has two consequences: a) it makes the sound of the word become a 'good' sound and b) it specifically connects this sound with a particular kind of goodness." As a result of this behavior, sounds become positively associated with basic satisfaction of pleasure and comfort (46). "Hence through a sort of built-in, self-directed and self-rewarded rehearsal, the bird learns to say 'hello' to himself but only after having first learned that it 'means something nice': things will be better now."

As the "trainer" gives food and other pleasurable attentions these stimuli become associated with a "comfort reaction" which helps to reinforce behavior.

As a result of this association between "trainer" and bird, Mowrer states (46), "If therefore, hearing the trainer say 'hello' makes a bird 'hopeful of good things to come,' it follows that the bird will also become hopeful, and 'happy' upon hearing itself make this noise and will, for the reasons given, be secondarily or 'autistically' rewarded for having made the response that produced this sound." This entire process is a type of conditioning to an emotional, subjective reaction. Illustrating the operation of the theory, the author states (46):

> ...the bird that is being trained to talk is familiar with two very different situations: one, situation-without-trainer, wherein the bird is lonely, bored, and possible hungry and thirsty; and two, situation-with-trainer, wherein the distress ends and comfort and well-being ensue. The word-noise, 'hello,' is a part of Situation Two; and if the bird can itself produce this sound, it can make unpleasant Situation One somewhat more like pleasant Situation Two. In short, by making the word-noise, 'hello,' the bird changes the situation psychologically, in a favorable direction.

Following the acquisition of words autistically learned (48), "...the infant discovers that the making of these sounds can be used not only to comfort, reassure, and satisfy himself directly, but also to interest, satisfy, and control mother, father, and others."

In summary, it is believed that sounds associated with primary reinforcement, such as feeding and relieving of thirst, have now acquired secondary reimforcing characteristics. Now (48), "...when the bird itself happens to make somewhat similar sounds, it is now secondarily rewarded for having done so and tries to perfect these sounds, so as to make them match as exactly as possible the original sounds, and thus derive from them the maximum of pleasure and comfort."

In describing the language development of infants the first assumption made by Mowrer is that "good mothers" are attentive and loving to their children, and that these mothers, while caring for the basic needs of their children, make soft and gentle sounds to them. This principle of applying sound while providing good and gentle care is the foundation of the "Autistic Theory of Language Development," and:

> Since the sound of the mother's voice has often been accompanied by comfort-giving measures, it is to be expected that when the child, alone and uncomfortable, hears his own voice, it will likewise have a consoling, comforting effect. In this way it may be supposed that the infant will be rewarded for his own first babbling and jabbering, without any necessary reference to the effects they produce on others.

Following these rewarding situations, the child is able to perceive words as uttered by the mother which precipitate additional reassurance. When the child makes a babbling sound of his own which is like a sound that the mother has been making (47), "...the child is motivated to reproduce that noise over and over and to try to perfect it, since a perfect reproduction of it is more satisfying than is an imperfect one." This may be called (47), "...a kind of self-contained trial and error learning; there can be no objection, provided we remember that it has been preceded by important emotional conditioning and that the success of the infant's efforts at vocalization is not necessarily dependent upon the reactions of others." It appears that at this stage it is the child's reactions to sounds which are important.

Continuing with this rationale, Mowrer states:

> I mean specifically, that when a child or a bird is lonely, frightened, hungry, cold or merely bored, it can comfort and divert itself by making noises which have been previously associated with comfort and diversion. These sounds have become 'sweet music,' and they are reproduced, not because of their social effectiveness, but because of the intrapsychic satisfaction they provide.

As in the case of birds, now a second stage of language learning can result in communicative language.

After publishing a critical analysis of existing learning theories (46) and rejecting their explanation for language acquisition, Mowrer (49) proposes a general theory of learning called the "Two-factor Learning Theory." He writes:

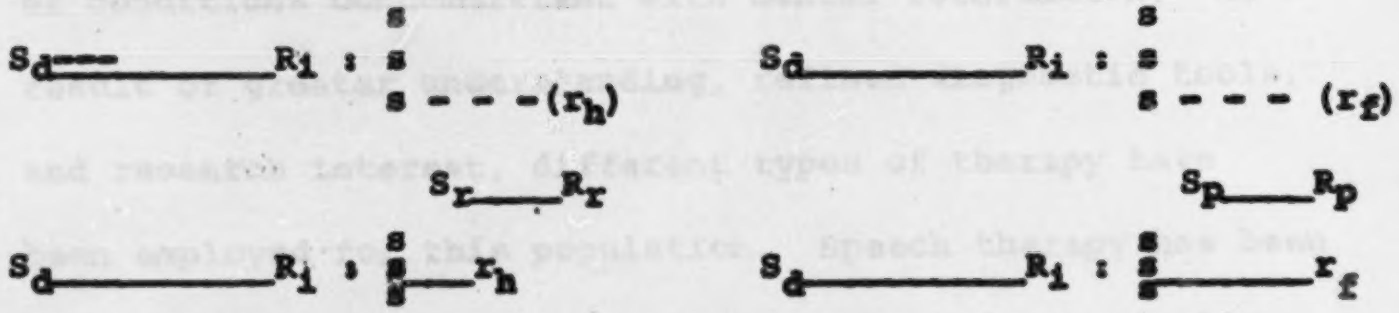
> Habit Strength, then is a matter of whether or not an organism is or is not disposed to make a particular response in a particular situation; and this, in turn, is a function of whether that response, made in tentative, token form (subjectively formulated as an 'inten-

> tion') produces a predominantly favorable or unfavorable feedback. If the stimuli which are produced by the response have more fear than hope conditioned to them, then the feedback is unfavorable and the response will not be allowed to proceed beyond the 'formative' stages (symbolic); but if the response-correlated stimuli have more hope than fear conditioned to them, the feedback is favorable and the nascent form of the response will go over into overt action.

Discussing his Two-factor Learning Theory, which originally consisted of both sign and solution learning, Mowrer (50) explains:

> Two-factor Learning Theory, as envisioned a decide ago, accepted essentially unmodified, the "first half" of the Law of Effect, which held that reward strengthens habit; but it departs from the Law of Effect in holding that punishment achieves its action, not by simply revising the effects of reward, but by causing fears to become attached (conditioned) to stimulation associated with the occurrence of the punished response.

Continued observations of the conditions of secondary reinforcement and feedback theory led to a revision of the Two-factor Theory. Mowrer (50) outlined the revised theory in the following manner:



The diagram is explained as follows (50):

> Here it is assumed that habit formation is a matter of conditioning no less than is punishment. If a stimulus, S_d, produced a given response, R_i, and R_i

> is followed by reward, S_r, then it is assumed that a part of the total response, R_r, which is produced by Sr, will become conditioned to the stimuli inherently connected with R_i. Here the conditionable component of R_r is r_h, the "hope" (secondary reinforcement) reaction; and it becomes connected to stimuli, *s*, *s*, *s*, just as fear does in the case of punishment. The result is that whenever R_i starts to occur, it is facilitated rather than inhibited.

In consideration of the apparent lack of opportunity that institutionalized mentally retarded children have to make close associations with normal speaking adults, and the apparent attention and affection that these children seek, an attempt to create a clinical tool from the newly developed theory seems justified.

In final summary of this introductory material, it was noted that speech and language handicaps occur with high frequency in mentally retarded institutionalized persons. The speech disorder can be associated with the etiology of the mental retardation, or it can be the result of conditions concommittant with mental retardation. As a result of greater understanding, refined diagnostic tools, and research interest, different types of therapy have been employed for this population. Speech therapy has been administered and results have been evaluated. Generally, it sppears that the mentally retarded child can benefit from speech therapy.

A need exists for a study which would compare the effectiveness of traditional speech therapy techniques and techniques specifically designed for mentally retarded individuals. The reported studies in speech habilitation of the mentally retarded indicated that most investigators utilized standard or slight modifications of existing speech therapy techniques. In the present study, a standard speech therapy program and a technique developed for mentally retarded subjects based on the "Autistic Language Development Theory" will be employed, and the efficiency of the two techniques will be compared.

STATEMENT OF THE PROBLEM

The present investigation was designed to develop and evaluate an articulation therapy technique for mentally retarded subjects based upon the Mowrer Autistic Language Development Theory. Primarily, the objective of the present study was to compare the effectiveness of the experimental technique with a traditional speech habilitation method developed by Travis (72) and expanded by Van Riper (74).*

As a sub-goal, this investigation attempted to explore the relation between and among pre-therapy articulation scores, measurements of I.Q., social quotient, reading readiness, family influence,** previous psychiatric service,** etiological classification,** age and sex of subject, as factors bearing on post-therapy articulation scores.

Variables analyzed to study the effects of therapy were: 1) number of articulation errors made on three articulation tests, 2) number of errors on two criterion consonant sounds, 3) improvement of the two criterion consonant sounds during a 40-day therapy period, 4) improvement of six other consonant sounds, and 5) ratings of clarity of spontaneous speech.

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*The speech therapy method described by Travis and Van Riper will henceforth be called the stimulus method, and therapy based on Mowrer's theory will be called the experimental method.

** Explained in detail in PROCEDURE.

Relative to certain institutionalized mentally retarded children, this investigation is seeking answers to the following questions:

A. With respect to the criterion variables - three consonant articulation tests, two critical phonemes included in the articulation tests, and judgment of the clarity of spontaneous speech - are there effects attributable to the method of speech therapy (treatment) employed?

B. With respect to the same variables, are there effects attributable to one or the other of the two speech therapists utilized?

C. With respect to the same variables, are there effects attributable to one or the other of the two intelligence levels into which the subject sample was divided?

D. With respect to the same variables, are there effects attributable to the interactions among the main effects listed above: treatment by therapist, treatment by intelligence level, therapist by intelligence level, or treatment by therapist by intelligence level?

E. Which of the following variables or combinations of variables can best be utilized as predictors of post-therapy articulation score?

1. Pre-therapy score on two criterion tests
2. Age
3. Sex
4. Intelligence Quotient

4. Intelligence Quotient
5. **Social Quotient**
6. **Reading Readiness Score**
7. **Family Influence**
8. **Etiological Classification**
9. **Previous psychiatric service.**

PROCEDURE

Subjects

The subjects employed in the present investigation were institutionalized mentally retarded children. Prior to initial screening, criteria involving age, hearing acuity and communicative language ability* were established. To typify a school population, children ranging in age from six years to sixteen years and eleven months were included. Auditory acuity, being a functional aspect of the therapeutic techniques employed, was controlled by rejecting subjects manifesting hearing losses. Finally, since the experiment involved articulation production, only subjects capable of communicative language were included.

The first step in the selection of the sample was the administration of an object articulation test to all residents of the Fort Wayne State School who could be brought to the institution's Speech and Hearing Clinic. This object articulation test is composed of 43 key words which contain 24 test sounds in various positions.**

The tests were administered by five trained speech and hearing therapists, each of whom had completed the course work necessary to meet the academic requirements for basic certification by the American Speech and Hearing Association.

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* The term "communicative language" as used in this experiment signified that a subject could correctly identify objects used in the Fort Wayne Object Articulation Test by uttering a word in such a manner that the examiner could score the key sound in the word, either with or without auditory stimulation. The subject had to produce at least 10 words in this manner.

** A copy of the Fort Wayne Object Articulation Test is presented in Appendix 1.

Items in the test were presented for visual inspection and the subject was asked to identify each of the objects. If the name of an item was not given spontaneously, the subject received one auditory stimulation identifying the object and was instructed to repeat the word. If the subject did not repeat the word, the experimenter proceeded to the next test object. Following this step, the subjects were given six auditory stimulations for each sound which had been incorrectly produced. Upon the cessation of this oral stimulation, they were asked to repeat the sounds.

A total of 1,515 individuals were tested*. Those who were not tested were either too incapacitated to be brought to the clinic, or were away from the institution on convalescent leave, on wage parole, or on the farm. Infirmary patients were tested in order to include all eligible subjects within the age range of the group studied.

From this population of 1,515 patients, 296 children between the ages of 6 years and 16 years, 11 months, were tentatively selected on the basis of test scores. From this group of 296 children, 177 who demonstrated communicative language were selected. The final selection of subjects for this study was made from this group.

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* A summary of the speech analysis of 1,104 available subjects from the total of 1,515 subjects is presented in Appendix 2.

Final Selection of Subjects

The 177 subjects were assigned to one of two levels based on individual I.Q. scores derived from the Stanford-Binet, form L or M, the Wechsler Intelligence Scale for Children, Kent EGY, or the Kuhlmann Test for Mental Development. These I.Q. scores were furnished by the Psychology Department of the Fort Wayne State School. In Level 1, subjects had I.Q. scores ranging from 12 to 44 and in Level 2, the I.Q. scores ranged from 45 to 79.

A pure tone audiometric examination was administered prior to the final selection of subjects. Each child was given an individual test in a sound treated room at the institution's speech and hearing clinic.* A Beltone (Model 10-A) pure-tone audiometer was used for the audiometric evaluation. The experimenter tested each ear at a sensation level of 15 db for the octave frequencies from 125 to 8,000 cps. Subjects were rejected when hearing loss exceeded 15 db on two frequencies in one ear or one frequency in both ears.

Conventional audiometric techniques were adapted to the limitations of mentally retarded subjects. The subject was instructed to raise his hand at the presentation of a tone. The subject was given the experience of listening to a 1,000 cycle tone at a level of 50 db, after which the examiner tested the frequencies of 2,000, 4,000, 8,000, 500, 250, and 125 cycles per second respectively. This procedure was followed for each ear individually. For those subjects who did not respond to the hand signal method, the ear-choice technique (13) was employed. In this technique, the tone was switched from ear to ear, requiring the subject to indicate the ear in which the signal was heard. If a subject did not respond to either of these two techniques, a conditioning-game was used. Children were conditioned to respond to a tone by placing rings on a ring-stand, or by placing blocks in a wooden receptacle. Subjects who could not be tested by any of these methods were rejected from the study. Audiometric conditions reduced the number of eligible children from 177 to 124,* since 26 of the 98 children in the upper I.Q. level and 27 of the 79 children in the lower I.Q. level failed the audiometric screening test.

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* The audiometric room was 11 ft. in length, 8 ft. 1 in. in width, and 9 ft. in height. Ambient noise level in the testing room was 35 db as measured with an H. H. Scott Sound Level Meter (Type 410-A), H. H. Scott, Inc., Cambridge, Mass.

Using a series of random numbers for both I.Q. levels, 72 subjects were finally selected for the study, and were arranged into four groups as shon in Table 5.** Therapy programs were administered to two of the four groups. Group 1 was designated to receive the experimental therapy and Group 2 to receive stimulation therapy. Two groups were retained to serve as controls. The children in Control Group 3, consisting of six subjects from each I.Q. level, participated individually in a structured situation in which free play, approval,

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[*] Ten children were further eliminated from the potential experimental sample because of absence of articulatory errors on sounds included in the experimental investigations.

[**] See Appendix 3 for the age, sex, date of last admission, and I.Q. of the 72 subjects participating in this study.

Table 5

Mean I.Q. Level and Sex of Subjects Arranged in Groups

Treatment	Therapist 1		Therapist 2		Control 3		Control 4	
	I.Q. Level		I.Q. Level		I.Q. Level		I.Q. Level	
	Lower 1	Upper 2	Lower 1	Upper 2	Lower 1	Upper 2	Lower 1	Upper 2
1) Experimental Therapy								
Number of Subjects	6	6	6	6				
Male	4	4	4	4				
Female	2	2	2	2				
Mean I.Q.	32	50	32	52				
2) Stimulus Therapy								
Number of Subjects	6	6	6	6				
Male	4	4	4	4				
Female	2	2	2	2				
Mean I.Q.	34	60	33	56				
Number of Subjects					6	6	6	6
Male					5	4	2	4
Female					1	2	4	2
Mean I.Q.					38	55	35	60

and reward were available without formal speech therapy. Group 4, also consisting of six subjects from each I.Q. level, served as an unstructured control group.

Description of Articulation Tests

A series of four articulation tests was administered to each of the 72 children comprising the four groups of subjects and their oral responses were recorded on a high fidelity magnetic tape recorder. The sounds included in the test battery were the voiceless / θ / in three positions, and the / v / in the initial and medial positions. In addition to these sounds, the medial /ʃ / , medial / t /, final /ʒ /, medial /ð /, and the initial / r / and / s / were tested. The selection of the test consonants resulted from an analysis of the frequency of errors made on the initial articulation test administered to the original 177 subjects considered for the experiment. This analysis revealed that the voiceless /θ / in three positions, and the / v / in the initial and medial positions represented five of the ten sounds most frequently misarticulated.* It should be noted that the /θ / and / v / sounds occur late in the development of speech and appear less frequently in spoken speech than most other speech sounds (51, 68, 72).

In the pre-therapy and post-therapy sessions, the four tests were randomly administered to each subject individually. The items within the tests were randomly assigned, and the same randomization was used for each subject.** A picture test was reconstructed from the

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* A summary of the rank order of the speech errors is presented in Appendix 4.

** The test items are presented in Appendix 5.

Bryngelson-Glaspey Test Cards (10) using the following pictures: bottle, thumb, valentine, red barn, washing machine, davenport, (because many children could not identify a picture of a davenport, a television set was presented after the card depicting the davenport*), stove, toothbrush, sun, feather, orange, and teeth.

An object test which was included in the battery contained these items: stove, feather, ring, bathtub, envelope, button, bar of soap, orange, valentine card, flashlight, teeth, and thumb, for which the examiner pointed to his own hand for recognition. This object test had been used at the Fort Wayne State School prior to this experiment, and most of the subjects were able to identify correctly the items presented.

The third test was an auditory stimulus test, in which each criterion consonant was combined with four vowels. The examiner sat behind and to the right of the subject, so that he was out of the child's sight, and uttered nonsense syllables which the child was told to repeat after one stimulation. A total of 48 sounds were presented in this test series.

The final test in the battery was an evaluation of each subject's clarity of spontaneous speech. A sample of approximately one minute of spontaneous speech was elicited from each subject.

Psychological, Sociological, Educational, and Diagnostic Information

Each of the 72 children in the study was rated on a Vineland

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[*] In order to score items from only the Bryngelson-Glaspey Cards, this item was not scored.

Social Maturity Scale and a Gates Reading Readiness Test. Prior to the start of therapy, or within the first week of therapy, a staff psychologist and a teacher or a cottage supervisor of the institution rated each of the 72 children on the study on the Vineland Social Maturity Scale and a teacher and the acting chief of the academic section of the institution administered the Gates Reading Readiness test to each child. In addition to the above information, the Social Service department provided the following information for each subject: the number of parental visits each child received at the School, the number of times the child left the School on a visit, and the number of letters and packages each subject received for the months of September, October, and November, 1957. This information was combined to give an arbitrary score called 'Family Influence.' Five points were given for every visit away from the School, three points were given for every visit the subject received, and one point was given for every letter or package that the subject received during the designated period. The Psychology Department furnished qualitative behavior summaries for the subjects in the study, and also provided information as to whether or not a child had been seen by a psychiatrist because of a behavior problem. For the variable labelled 'Previous Psychiatric Service,' if a child had been referred to a staff psychiatrist for behavioral difficulties, he was given a score of one. A score of two was given if the child had not visited a psychiatrist. In the category of etiological classification, a score of one was arbitrarily assigned for subjects whose retardation was diagnosed as familial and a score of two was assigned for any classification other than familial. The classifications were obtained from the School's psychological files.*

Instrumentation for Recording Speech Sample

A tape recorder, Berlant Model BHX-2, (24), operated at seven and one-half inches per second, was used to record the speech tests of each subject. The microphone level control was adjusted for each child to prevent the signal peaks from reading 100 on the meter scale.

Channel 1 on the Berlant recorder was used for both the pre-testing and post-testing sessions. The frequency response for Channel 1 of the Berlant recorder at a 60 db level at a tape speed of 7.5 inches per second, was found to be plus or minus 4.5 db from 50 to 4,000 cps, dropping off to minus 7 db at 7,000 and 10,000 cps. The frequency response curve for the Berlant recorder is indicated in Figure 1.

In order to procure good quality recordings of the subjects' responses to the test material, a Shure Cardioid Dynamic Microphone, Model 556B was coupled to the Berlant recorder. The frequency response of the microphone is estimated to be relatively flat from 40 to 15,000 cps.**

Articulation Test Method

The articulation testing program was administered in a speech therapy room at the Fort Wayne State School.*** Identical methods were

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* See Appendix 6 for the data discussed in this section.

** Based on correspondence with Shure Brothers, Chicago, Ill.

*** The room was 16'6" in length, 11'5" in width, and 10'3" in height. The ambient noise level in the testing room was 35 db, as measured with an H. H. Scott Sound Level Meter (Type 410-A), H. H. Scott, Inc., Cambridge, Massachusetts.

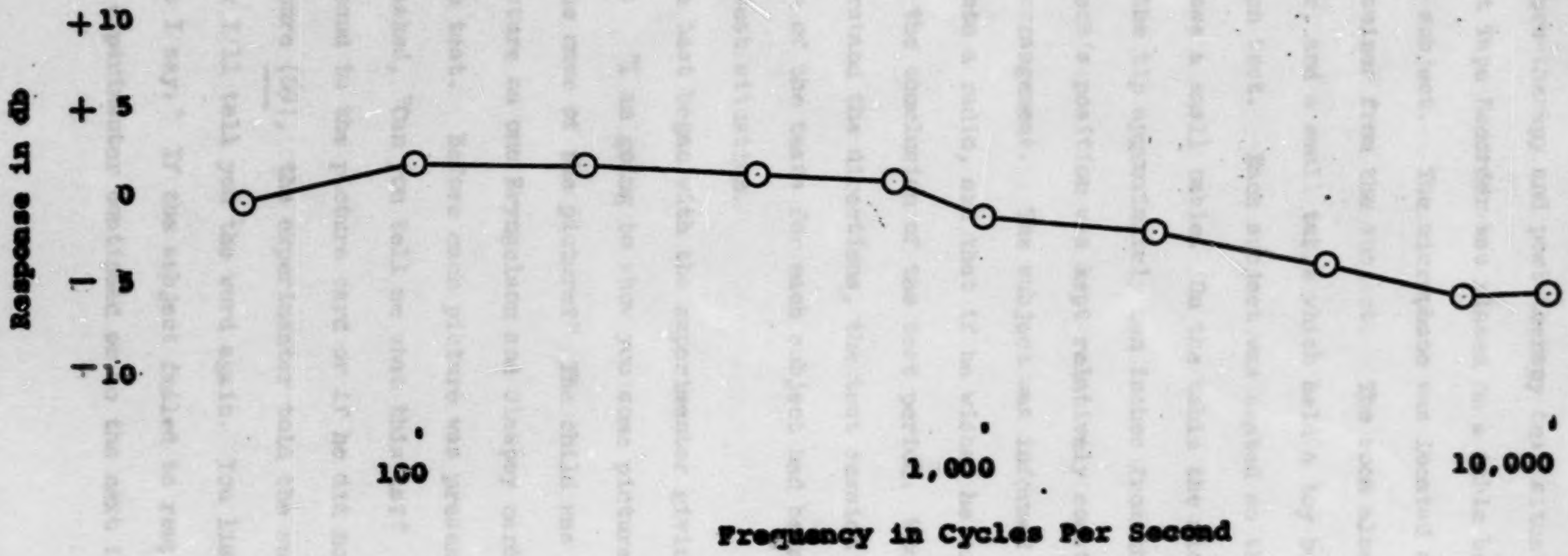

Fig. 1. Frequency Response of Berlant Tape Recorder (tape Speed 7.5 inches per second)

employed in the pre-therapy and post-therapy test situations.

The Berlant Tape Recorder was placed on a table behind the examiner and the subject. The microphone was located on a table which separated the examiner from the subject. The room also contained windows, a mirror, and a small table which held a toy house used in the spontaneous speech test. Each subject was seated so that he faced the examiner across a small table. On the table the microphone was positioned with the tip approximately ten inches from the subject's mouth. The subject's position was kept relatively constant by the chair and table arrangement. The subject was informed that he was going to speak into a radio, and that if he wished he could hear himself speak at the conclusion of the test period. When the subject appeared to understand the directions, the test session was started. The randomization of the tests for each subject had been prepared previous to the test situation.

The picture test began with the experimenter giving the following instructions: "I am going to show you some pictures. Will you please tell me the name of the picture?" The child was asked to give the name of a picture on one Bryngelson and Glaspey card that was not being used in the test. Before each picture was presented to the subject, he was asked, "Can you tell me what this is?" If the subject did not respond to the picture card or if he did not correctly identify the picture (69), the experimenter told the subject, "That is right, but now I'll tell you the word again. You listen and then say the word that I say." If the subject failed to respond to this stimulation, the experimenter continued on to the next item. The pictures were placed flat on the table. If the subject wished to pick up the card and examine the picture, he was permitted to do so.

The same procedure was utilized for the administration of the object test. Prior to the beginning of the object test, the subject was shown a toy dog which he was asked to identify. This object was not used in the test, but it was inserted to determine whether or not the child understood the instructions accompanying the test. Each object was presented to the subject; again, as in the picture test, the subject was permitted to handle the object if he so desired. The test objects not being used were kept to the left of the examiner in a large paper box out of the subject's view. As in the picture test, when the subject failed to respond to the initial presentation, he was given one stimulation by the experimenter.

For the auditory stimulus test, the subject was informed that the experimenter would be seated to his right and out of his view. He was asked to imitate the experimenter by repeating nonsense combinations of sounds. In order to determine whether or not the subject understood the directions of the auditory stimulus test, he was asked to repeat a nonsense sound combination not used in the test. When the experimenter felt that the subject understood the directions, the test was initiated. If the subject did not repeat the examiner's utterance after the initial presentation, he was given one additional stimulus.

In the fourth of the criterion tests, subjects were instructed to respond to a series of questions which were designed to elicit a measurable sample of spontaneous speech. The following were the questions asked of each subject: 1) What did you do during Christmas? 2) What kind of presents did you get for Christmas? Following the responses to these questions, the subject was asked to look at a toy house situated on his left. After viewing the house the subject was instructed to tell the examiner what he saw in the house, and what activities could be performed there. Each subject was then instructed to look at Tell Set 3 of the Reading Readiness Picture Cards (70) which had been stapled in sequence, and to tell the examiner what he saw. The experimenter kept a stop watch in his hand, out of view, and concluded the test when the subject had spoken for approximately one minute. If the subject failed to speak that long, the experimenter showed the subject of a dog chasing a cat and a bird into a tree and asked him to tell what he saw.

At the beginning of each test, after the experimenter had explained the instructions, the Berlant recorder was started. The order of the test presentation was randomized for each of the subjects, but the items within the tests remained constant. There was a short break between each of the four tests and at the conclusion of the tests the subject was praised and dismissed.

Therapists

Two speech therapists of the Fort Wayne State School staff participated in this study. Both therapists had majored in speech and hearing therapy and had been graduated from college with Bachelor's degrees in June, 1957. For each, this was their first professional position in speech and hearing therapy. One therapist, a male, began working in June, 1957 and the other therapist, a female, began working one month later. Before this study was activated,* both therapists had the opportunity to administer speech and hearing tests to mentally retarded children in addition to engaging in therapy with older residents at the State School. The elementary school teacher who met with the 12 children in the special control group was graduated from college with a Bachelor's Degree in Education in 1954. She had two years of teaching experience prior to the beginning of therapy.

Daily Lesson Plans

The speech therapy program was conducted at the Speech and Hearing Clinic of the Fort Wayne State School. The therapy sessions extended over a period of 40 days: 20 days for the / θ / sound in the initial, medial, and final positions, and 20 days for the / v / sound in the initial and medial positions. Each therapy session was approximately 15 minutes, daily, over a five-day week. The first 20 days of therapy were directed exclusively to the / θ / sound, and the following 20 days were used for the / v / sound. For six days during the final therapy sessions, the / θ / sound was reviewed.

Both the stimulation and the experimental therapy programs were administered during the same time period. Therefore, during a working day, a therapist would see children in both the experimental and stimulation programs. An attendance log was kept so that the therapists knew each child's daily schedule. Magnetic tape recordings were made of one child's therapy sessions during the second half of the

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[*] Therapy was initiated on February 3, 1958 and was concluded April 9, 1958.

experimental program. These sessions were tape recorded for use as a future teaching aid.

If a child missed an appointment because of illness or some other reason, a makeup session was held. An attempt was made to schedule these makeup sessions between regularly scheduled appointments. Both therapists used the same time schedules for their daily lessons.

Due to the nature of the study, the therapy program was maintained on a specified time schedule even though a given subject may not have progressed to the point of therapy that was included in the lesson plan.

To avoid any frustration on the part of such children for failing to grasp the daily assignment, a portion of every therapy session was devoted to reviewing the previewing the previous day's work. The subjects were able to produce all words which were used in the daily lesson plan, although their production may have been faulty. Instructions were kept on a level that could be understood with little difficulty, and the therapy games were designed for quick recognition and as an aid in maintaining interest. Some variation in the daily procedure was permitted if the child could not or would not perform.

None of the test words or nonsense syllables used in the articulation tests was employed as part of the daily lesson assignment.*

Before the therapy program was concluded, an Easter vacation was declared at the State School. To match the subjects leaving the institution for the vacation period, an equal number of children in the two therapy groups and control group 3 (group meeting teacher) was withheld from participation in the program for the duration of the vacation. This procedure necessitated the removal of two children from each of the sub-groups for a period of seven days until the vacation was over. Although it had the mechanical effect of giving equal therapy time to those children who remained at the School and to those who had gone home, it would be difficult to measure the subjective value of being at home as compared with remaining at the School.

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* See Appendix 7 for a list of nonsense syllables, words and sentences used in the therapy program.

The daily clinical program for Control Group 3 remained the same throughout the 40-day period. These children met individually with the elementary school teacher in a therapy room with appropriate tables and chairs. A large table contained toys, games, coloring paper, paste, books, magazines and other articles. If a child wished to use some object that was not in the room but was within the clinic structure, the instructor would make an attempt to obtain the article for the child. The children were permitted free access to every part of the room. The instructor made no attempt to engage any of the children in conversation, but if the children asked questions, she would answer in a friendly manner. Throughout the free play period, the instructor rewarded the children with candy or cookies and verbally praised the children for their efforts.

The daily lesson plan for the children assigned to the stimulus method therapy group was developed from published suggestions by Van Riper (74). Since the study had been set up for a 20-day period for each of the two criterion sounds, the experimenter arbitrarily divided the time period into five units of varying length: (a) ear training, five days; (b) stimulation and production of sound in isolation and nonsense syllables, three days; (c) strengthening the production, three days; (d) making the transition to words, six days; and (e) using the words in sentences, three days.*

To develop daily lesson plans based on the "Autistic Theory," it was decided that the basic approach would be to reproduce a favorable association with the hearing of "good" sounds. Realizing that it would be impractical to provide vocalization concurrently with the relieving of such basic needs as thirst and hunger, it was decided that the children should be permitted every opportunity during the therapy session to have a pleasant, rewarding association with a specific speech sound produced by the therapist. Support for this concept is found in Mowrer's statement, (46), "It is seen that if positive emotional connotations can be given to certain sounds, as produced by others, the subject will, himself, have a strong disposition to make the responses which produce these sounds without as yet ever having made or having ever been rewarded for making them."

In this experimental approach the children were stimulated with speech sounds and words. The subjects were rewarded after the clinician produced the speech signals. Each child was rewarded a number of times during a clinical session, since (46),

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* Daily lesson plan program is found in Appendix 8.

> The important thing is simply to get stimuli which ordinarily accompany a given response to be experienced and then be followed by the appropriate type of effect (reward or punishment). The reason that practice or repetition of the response itself is often necessary is that, under some circumstances, it is only by its occurrence that the correlated stimuli can be produced and conditioned, to hope or fear, in the manner indicated.

The foundation for the clinical approach employed by the present investigator can be summarized by citing Mowrer (46):

> Since a word response can be made by one person and its (major) sensory consequences experienced also by another, the resulting stimulation can be conditioned to hope and the basis thus laid for the other to start making the word sound then, without having previously done anything but 'listen.' Likewise, an individual can be preconditioned or prejudiced against making a particular sound by simply hearing another make it and then experiencing something unpleasant.

As in the stimulation program, the / θ / sound was offered in therapy for the first 20 days in all three positions, and the / v / sound was offered during the last 20 days, in the initial and medial positions. During each therapy session of the first 20-day period, the therapist stimulated the child with the / θ / in all three positions; the procedure was the same with the / v / in the initial and medial positions in the second 20-day period.

The therapists were instructed to engage the children in friendly conversation. They never asked the child to produce the criterion sounds, but if the child responded by making such sounds, their productions were accepted and the subject was praised. The subjects were stimulated with the criterion sounds at least ten times during each therapy session.

The 20-day therapy period was divided as follows:

a) the first five days, free play; b) the next two days, "stimulus-reward" with the sound in isolation; c) the following three days, "stimulus-reward with nonsense syllables; d) the next four days, "stimulus-reward" with words; e) the following four days, "stimulus-reward" with sentences; and f) the final two days, "stimulus-reward" in general conversation.*

Analysis of the Recorded Tests

Upon the completion of the post-therapy testing sessions,** a panel of five trained judges were assigned to rate both the pre-therapy and post-therapy tests. To eliminate bias by the judges in favor of the post-therapy test results, the experimenter randomized 37 tapes containing the test responses of the subjects in the experiment. In order to conceal the identity of the subject and his group, each subject's recording was given a code number.

Two of the five judges had received M.A. degrees in Speech, and were candidates for the Ph.D. in Speech Pathology. The three remaining judges had completed their B.S. degrees with majors in speech, and were M.S. candidates in Speech Pathology. All of the judges had had experience in administering and scoring articulation tests. An assistant to the experimenter played the tape recordings to the panel of judges. Prior to the playing of a tape, the judges were given scoring booklets containing individual test blanks in the order that they appeared on the tape recordings.

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* Daily lesson plan program is found in Appendix 9.

** The four criterion tests were re-administered immediately upon conclusion of the therapy program.

The judges listened to the tape reproductions in a sound-treated room approximately 17' in length, 14' wide and 10' high at the Purdue University Speech and Hearing Clinic. Prior to the start of the initial judging session, the judges were given instructions concerning the nature of the articulation test tapes and the scoring. They were instructed to examine the test blanks in order to become prepared for the sounds that were to be judged.* Each test blank was examined individually and the judges were given an opportunity to ask questions concerning the tests. They were instructed to check the box headed by the number 1 when a sound was correctly produced, the box headed by number 2 when a mildly distorted sound was produced, and the box headed by the number 3 when the sound was obviously distorted and indistinct. In addition, any omissions, substitutions, and additions were to be scored as 3.

The clarity of the spontaneous speech test was scored on the basis of a rating scale. The judges listened to speech samples and scored the tests as: 1, intelligible spontaneous speech; 2, subject could possibly benefit from a speech stimulation class; 3, spontaneous speech relatively unintelligible, lacking in clarity. The Berlant Model BRX-2-magnetic tape recorder, on which the tests were recorded, was also used to play-back the recorded tapes, arranged in randomized order. A tape speed of 7.5 inches per second was used for the playback on Channel 1, the channel employed to record the test material. The output level was controlled to maintain a comfortable loudness level for all five judges.

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* See Appendix 10 for a reproduction of the test forms.

Analysis of Data

The following was the manner in which the data for the analysis were collected:

Each of the 72 children studied in this experiment was administered a total of eight tests in pre- and post-therapy sessions. Five judges rated the test performances on each of the eight tests. Therefore a total of 40 ratings for each of the subjects was obtained. The number of errors made by the subjects on the object, picture, and auditory stimulus tests, as rated by each of the five judges, was calculated. For each of these three tests, the judges scored each item within the test separately. There were 12 items on the object test and picture test, and 48 items on the auditory stimulus test. Only those sounds that were scored as 3 by the judges were considered as error items. The score given to each subject on the clarity of spontaneous speech test was the average rating of the five judges. The instructions to the judges for the scoring procedures were outlined in a previous section.

In addition, all articulation errors (score 3) of the / θ / sound and the / v / were scored separately for each subject. These two sounds appeared in five of twelve items on the object and picture tests and four times in each position on the auditory stimulus test.

The criterion tests were analyzed for the following data:

1. The total number of errors a subject received on each of the three articulation tests (object, picture and auditory stimulus)

independent of position, as rated by the five judges before therapy, and the total number of errors at the conclusion of therapy.

2. The total number of articulation errors, scored by position of the two criterion sounds / θ / and / v /, in the pre-therapy and post-therapy testing sessions. The positions were initial, medial, and final for the / θ / sound, and initial and medial for the / v / sound. As described above, these scores were obtained from the five judges' ratings of three articulation tests.

3. The average rated judgments of the 5 judges on the clarity of spontaneous speech test prior to the beginning of therapy and the average rated judgments in the post-therapy testing session.

The pre-therapy scores for subjects six and seven for two of the tests employed were estimated on the basis of responses of subjects achieving similar test patterns. This procedure was necessary because of distorted tape recordings. For subject six, the clarity of spontaneous speech score was estimated, and for subject seven, the object test score was estimated. Two subjects were unavailable for post-therapy testing. Subject seven left the institution for an extended vacation, and subject fifty-eight went on convalescent leave. The post-therapy scores for these two subjects were estimated by using the within-cells regression for their corresponding groups. In preparing the analysis of covariance, this had the effect of reducing the degrees of freedom by two.

The following data were collected for each of the subjects in order to analyze for factors correlated with post-therapy test scores;

1. Sex
2. Age
3. Intelligence Quotient
4. Social Quotient
5. Reading Readiness Score
6. Family Influence Score
7. Visit to a staff psychiatrist for behavioral difficulties.
8. Etiological classification.

Statistical Treatment

The statistical techniques utilized in the present investigation were employed for the following purposes: 1) to analyze for differences in the nine criterion variables under investigation attributable to the four groups studied, the methods of therapy employed, the therapists, intelligence level, and the interactions of these listed main effects; 2) to determine whether, in a sample of mentally retarded institutionalized individuals, selected criterion values might predict post-therapy success on articulation tests.

For the statistical analysis, the subjects were arranged in cells as shown in Table 6. An analysis of covariance was computed for each of the nine variables under investigation to test for significance of the effects listed above. In addition, t-tests were utilized to test for significant differences between pre- and post-therapy test scores. For the t-tests the results for the upper level therapy groups and the

Table 6
Assignment of Subjects to Cells in
All Analyses of Covariance

Treatment	Therapist	I.Q. Level				Totals	
		Lower		Upper			
		Pre-therapy X	Post-therapy Y	Pre-therapy X	Post-therapy Y	Pre-therapy X	Post-therapy Y
Experimental	1	6	6	6	6	12	12
Therapy	2	6	6	6	6	12	12
Stimulus	1	6	6	6	6	12	12
Therapy	2	6	6	6	6	12	12
Teacher Control		6	6	6	6	12	12
Test Only		6	6	6	6	12	12
Grand Total		36	36	36	36	72	72

lower level therapy groups were pooled separately, control subjects being omitted. The t-tests were conducted over the nine variables studied.

Simple product-moment correlations were computed in order to determine whether or not any significant linear relationship existed between the independent and dependent variables measured or controlled in the study. The independent variables were: Sex, Age, I.Q., Family Influence,* Social Quotient, Reading Readiness, Etiological Classification,* and Visit to Psychiatrist.* Also included as independent variables in the two major correlational analyses were pretest articulation scores. The dependent variable studied in the first of the correlational analyses was post-therapy score on the auditory stimulus articulation test and post-therapy score for medial /v/ was the dependent variable in the second analysis. In both analyses, scores for both experimental therapy and stimulus therapy subjects were pooled, preliminary calculations having demonstrated similar patterning of results in these two groups. Finally, a maximum shrunken multiple coefficient of correlation was calculated for both groups of analyses, the attempt being to determine what combination of independent variables best predicts post-therapy articulation scores in the sample studied.

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* These values are explained in the Procedure Section.

RESULTS

Reliability of Judgments

In order to test the consistency with which the judges detected articulatory errors and scaled the clarity of spontaneous speech, internal consistency coefficients of reliability were calculated. The average intercorrelations over five judges for total scores on the four criterion tests in the pre-therapy and post-therapy arrays of data are revealed in Table 7. Satisfactory reliability is demonstrated in these coefficients, which ranged in magnitude from .628 (clarity of spontaneous speech, pre-therapy) to .898 (auditory stimulus test, pre-therapy).

Table 7

Average Intercorrelation Coefficients
Among Judges for Criterion Tests

Test	Pre-Therapy	Post-Therapy
Auditory Stimulus	.898	.869
Picture	.862	.833
Object	.846	.844
Clarity	.628	.745

Subject total error scores over all five judges and all tests were noted. These data were used in the analyses of covariance and in the calculation of further coefficients of reliability. Table 8 reports the total score reliability for the criterion tests, while Tables 9, 10, and 11 report reliability estimates based upon average intercorrelation coefficients in three individual consonant sounds, calculated in the same manner as the coefficients reported in Table 7.

Table 8

Reliability Coefficients for Judgment of Subject Total Scores on Criterion Tests

Test	Pre-Therapy	Post-Therapy
Auditory Stimulus	.978	.971
Picture	.969	.961
Object	.965	.964
Clarity	.909	.933

As expected, total test reliability (Table 7) was higher than reliability calculated for individual consonant errors. In Table 7 the coefficients ranged from .628 to .898, for pre-therapy clarity of spontaneous speech and post-therapy auditory stimulus, respectively, while the coefficients fell as low as .409 (post-therapy picture test)in Tables 9-11.

Table 9

Reliability Coefficients for Judgment of Articulatory Error on Initial /v/ Sound

Test	Pre-Therapy	Post-Therapy
Auditory Stimulus	.666	.702
Picture	.606	.535
Object	.670	.556

Table 10

Reliability Coefficients for Judgment of Articulatory Error on Medial / ʃ / Sound

Test	Pre-Therapy	Post-Therapy
Auditory Stimulus	.698	.762
Picture	.875	.409
Object	.639	.672

Table 11

Reliability Coefficients for Judgment of Articulatory Error on Final / θ / Sound

Test	Pre-Therapy	Post-Therapy
Auditory Stimulus	.627	.477
Picture	.582	.493
Object	.512	.661

Although the coefficients for the individual sounds were lower -- ranging from .409 to .875 for medial / ʃ / on the picture test, post-therapy and pre-therapy, respectively -- they were considered to be generally satisfactory for the further analyses employed in this experiment. This method of calculating reliability coefficients was described by Ebel (15).

Analyses of Covariance

In order to employ the analysis of covariance, it was first necessary to apply tests of homogeneity to the within-cells a) residual variances, and b) regression coefficients for each pair of variables. For the residual variances, Bartlett's tests (76) were used to test for homogeneity. The homogeneity of the regression coefficients was tested following the outline of Walker and Lev (76). The results of these tests confirmed that the data could be processed as being essentially homogeneous.

Although the results of this experiment were essentially negative, potentially important trends were noted. As revealed by Tables 12, 14, 16, 17, 18, 19, 21, 22, and 23, and illustrated graphically in Figures 2a,'b, and c, it was not possible to ascribe to one method of articulation therapy a clear-cut advantage over the other when applied to the present sample of mental retardates. In each of the analysis of covariance tables it will be observed that the F-ratio for the Treatment main effect failed to reach the magnitude required for significance at the five per cent level. Not only were the two methods found to be non-significantly different from each other; they were also non-significantly different from the two conditions of non-administration of any speech therapy. Hence a rigid interpretation of these statistical analyses would lead to very conservative conclusions concerning the merits of the speech therapy applied to the mentally retarded subjects.

However, certain of the analyses and observation of trends in the data permit a somewhat more liberal interpretation of the results. As the raw data of the study are examined, it appears that certain changes did take place in certain of the subject groups. While large

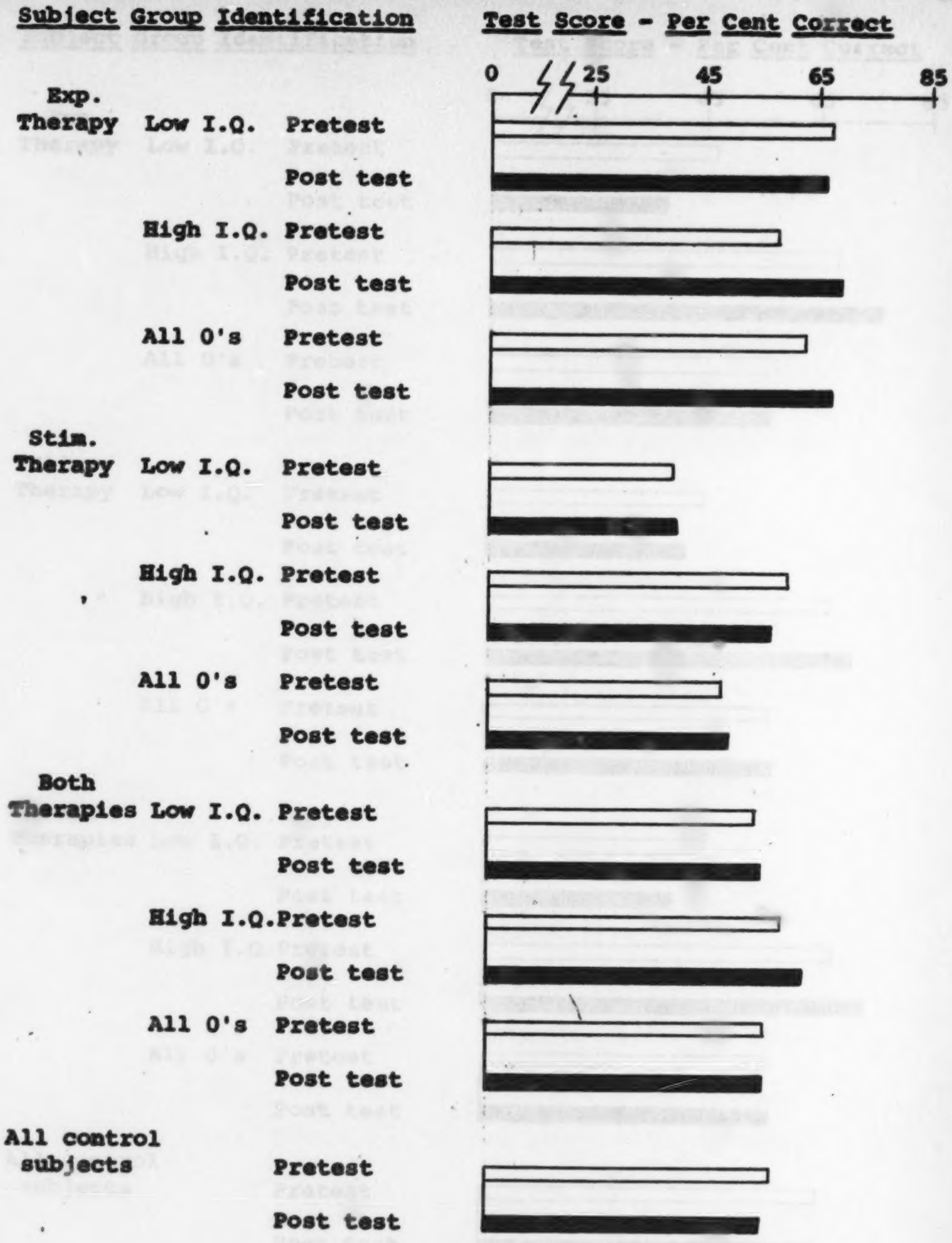

Fig. 2a. Object Articulation Test Scores by Groups (I.Q. Levels and Assignment to Treatments) Preceding and Succeeding Therapy Period - Therapist One.

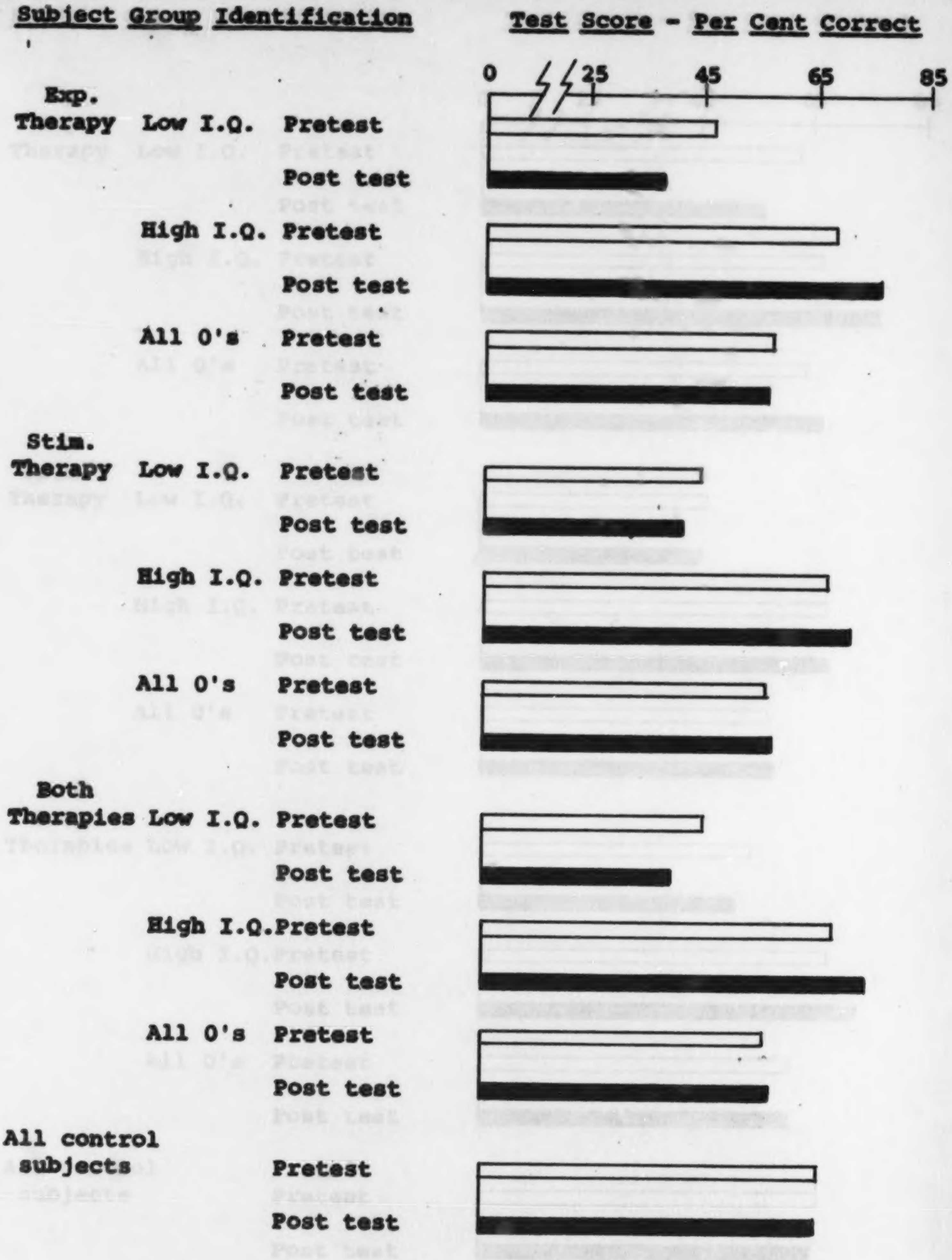

Fig. 2b. Object Articulation Test Scores by Groups (I.Q. Levels and Assignment to Treatments) Preceding and Succeeding Therapy Period - Therapist Two.

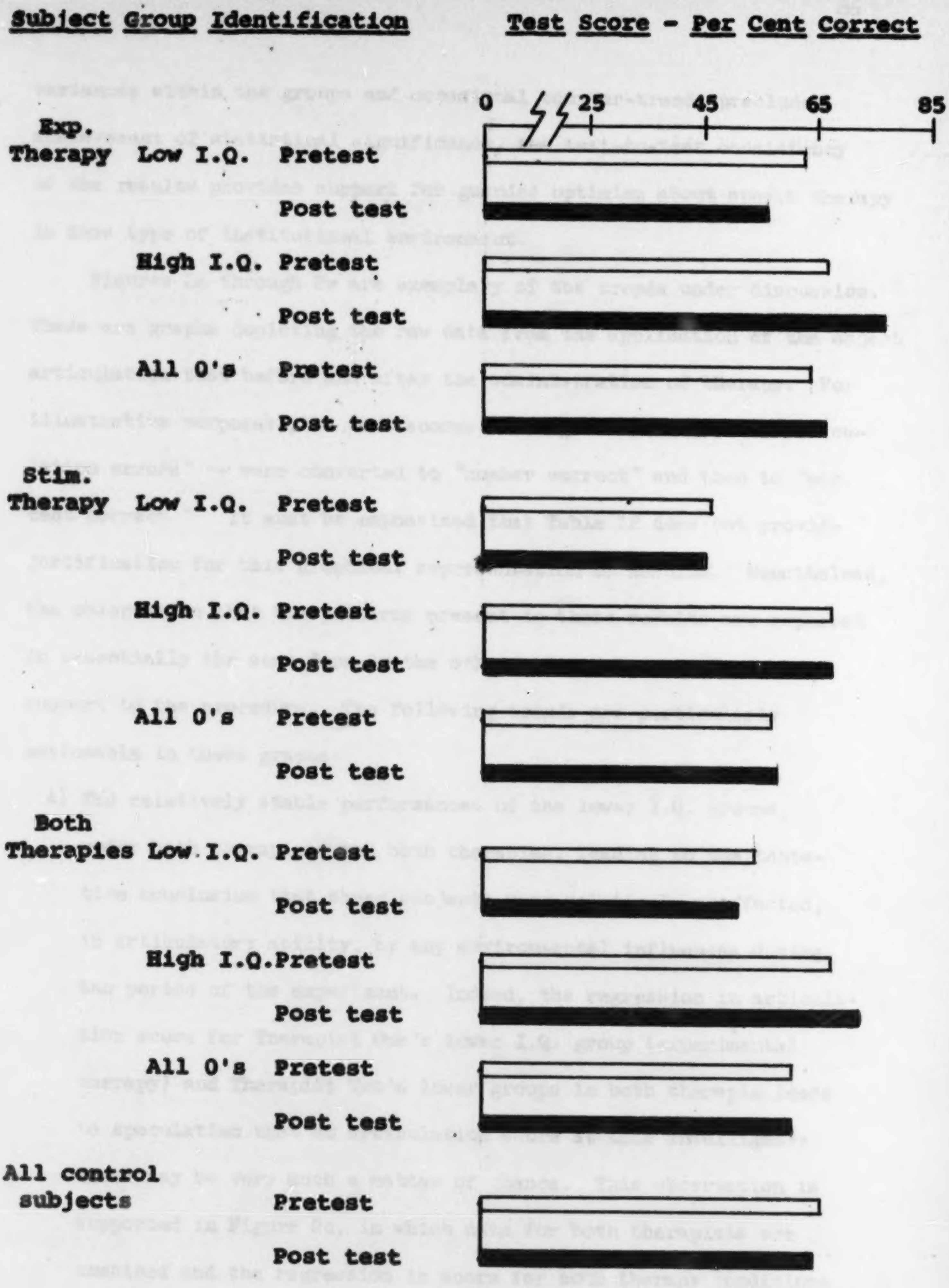

Fig. 2c. Object Articulation Test Scores by Groups (I.Q. Levels and Assignment to Treatments) Preceding and Succeeding Therapy Period - Both Therapists.

variances within the groups and occasional counter-trends precluded achievement of statistical significance, the test-to-test consistency of the results provides support for guarded optimism about speech therapy in this type of institutional environment.

Figures 2a through 2c are exemplary of the trends under discussion. These are graphs depicting the raw data from the application of the object articulation test before and after the administration of therapy. For illustrative purposes, the test scores -- originally "number of articulation errors" -- were converted to "number correct" and then to "per cent correct." It must be emphasized that Table 12 does not provide justification for this graphical representation of results. Nonetheless, the observation that the patterns present in these results are repeated in essentially the same form in the other criterion tests lends some support to the procedure. The following trends are particularly noticeable in these graphs:

A) The relatively stable performances of the lower I.Q. groups, under both therapists and both therapies, leading to the tentative conclusion that these subjects were relatively unaffected, in articulatory ability, by any environmental influences during the period of the experiment. Indeed, the regression in articulation score for Therapist One's lower I.Q. group (experimental therapy) and Therapist Two's lower groups in both therapie leads to speculation that an articulation score at this intelligence level may be very much a matter of chance. This observation is supported in Figure 2c, in which data for both therapists are combined and the regression in score for both therapy conditions is clearly delineated, revealing a pattern not dissimilar from that of the control subjects;

B) The consistent pattern of enhanced articulation score for the higher I.Q. groups assigned to the experimental therapy treatment. This may be observed for both therapists individually and collectively;

C) The inconsistency of the higher I.Q. groups assigned to stimulus therapy. In the case of Therapist One, a slight regression was noted, while in the case of Therapist Two a balancing enhancement of score occurred. Thus when scores from the groups under both therapists were lumped, a pattern similar to that of the controls and lower I. Q. groups emerged.

The general pattern of the test results having been described, succeeding paragraphs will be concerned with specific results and particularly with those shown to have statistical significance.

Object Articulation Test

As mentioned above and revealed in Table 12, the main effect of Treatments was non-significant when data from the Object Articulation test were analyzed. One source of variance, however, was found to yield an F-ratio which was significant at the 1 per cent level, and another fell just short of significance at the 5 per cent level. These were, respectively, I. Q. levels and the interaction Therapists by I.Q. levels. Adjusted mean error scores for these two effects are presented in Table 13 and illustrated graphically in Figure 3. (As in the case with Figure 2, Figures 3 through 7 were prepared by converting

Table 12

Analysis of Covariance of
Object Articulation Test Error Scores*

Source	d.f.	Adj.SSy	M.S.(y'x)	F
Treatments	3	184.353	61.451	1.124
I.Q. Levels	1	645.973	645.973	11.820**
Trt x Levels	3	220.815	73.605	1.347
Therapists	1	99.584	96.584	1.767
Th x Trt	1	100.022	100.022	1.830
Th x Levels	1	192.687	192.697	3.526**
Th x Trt x Levels	1	8.232	8.232	< 1
Within Cells	57	8286.11	54.653	

* Complete entries for this and subsequent tables, including sums of squares for pre-therapy and post-therapy tests, are on file at the Purdue Voice Communications Laboratory.

** Table values of F: .05 (1, 57) - - 4.01
.01 (1, 57) - - 7.10

error scores to positive values and calculating a "per cent correct" score for each condition. It is believed that interpretation of the results is facilitated by this procedure.)

Table 13
Adjusted Mean Error Scores for Object Articulation Test

Therapist	I.Q. Level	
	Lower	Upper
	31.50 *	25.34 *
1. (Female)	27.83	24.96
2 (Male)	34.78	23.78

* Main Effects.

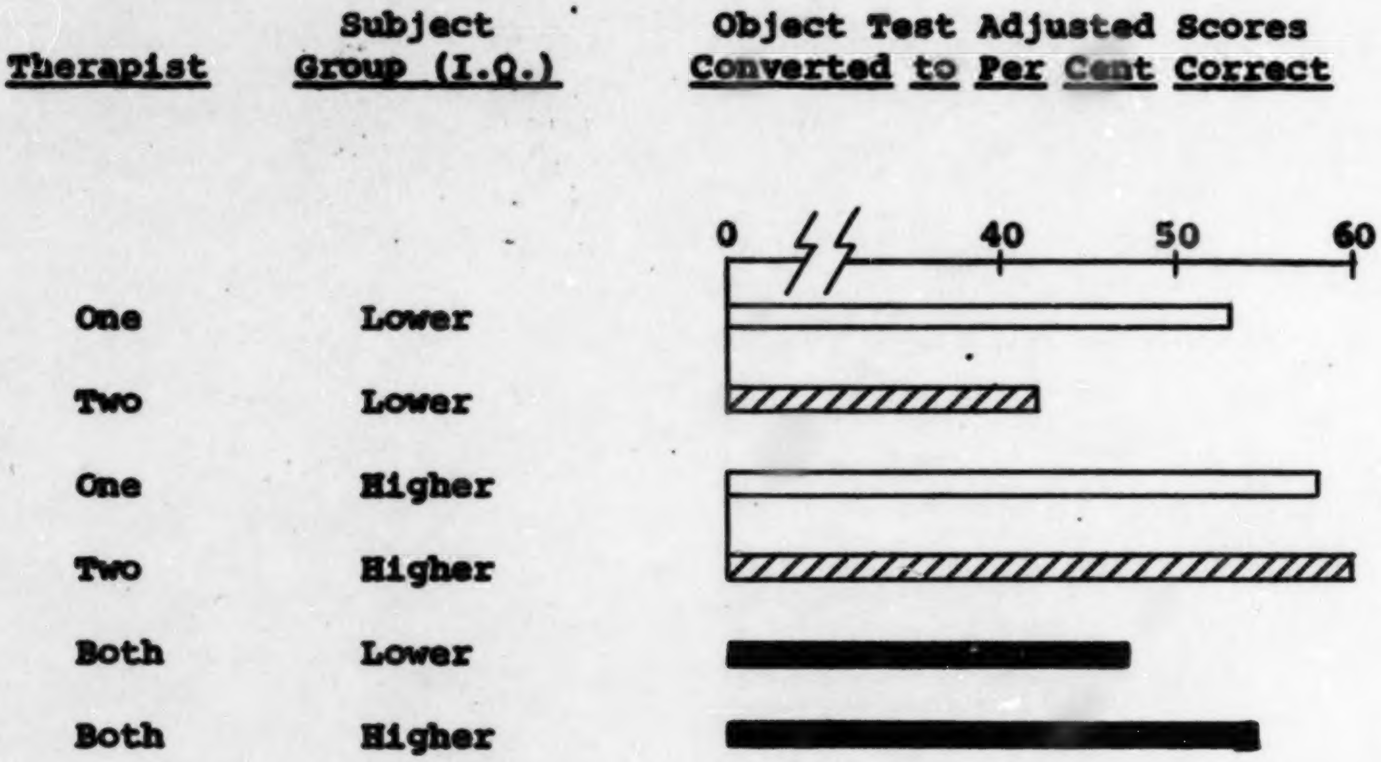

Fig. 3. Interaction of Therapists with Subject Groups (I.Q. Levels) Revealed by Object Articulation Test.

As revealed by the table and figure, the higher I.Q. groups performed better at the conclusion of the therapy period than the lower groups, adjustment having been made for initial test scores. However, it must be recalled that in this analysis the adjusted scores of the control subjects are included with those of the subjects who received therapy; hence the improvement in scores noted cannot be attributed solely to the effects of therapy. With respect to the Therapists by Levels interaction, it appears that the subjects from the lower I.Q. levels who received articulation training from Therapist One performed better than those from the same level who were assigned to Therapist Two. The difference in performance attributable to therapists among the higher level subjects was negligible.

Picture Articulation Test

Table 14 presents the analysis of covariance of picture articulation test scores. It will be observed that a significant F-ratio emerged from the data only in the Therapist by Treatment interaction. Adjusted mean error scores for the two treatments, presented in Table 15, are almost identical. However, comparison of the subject groups assigned to the two therapists reveals that the children who underwent the experimental therapy under Therapist One did materially better (smaller error score) than those assigned to the conventional stimulus therapy. Just the reverse was true for Therapist Two, whose stimulus therapy group achieved smaller adjusted mean scores (smaller error scores) than the experimental therapy group. This interaction is graphically represented in Figure 4.

Table 14

Analysis of Covariance of Picture Articulation Test Error Scores

Source	d.f.	Adj.SSy	M.S. (y.x)	F
Treatments	3	246.484	82.165	1.311
I.Q. Levels	1	182.583	192.583	3.074
Trt x Levels	3	164.971	54.990	< 1.
Therapists	1	1.209	1.209	< 1.
Th x Trt	1	373.829	373.829	5.967*
Th x Levels	1	36.920	36.920	< 1
Th x Trt x Levels	1	7.624	7.624	< 1
Within Cells	57	3571.085	62.651	

* Table values of F: .05 (1, 57) 4.01
.01 (1, 57) 7.10

Table 15

Adjusted Mean Error Scores for Picture Articulation Test

Therapist	Treatment 1. Experimental	 2. Stimulus
1	27.01	31.71
2	32.92	26.44
Both	29.96	29.08

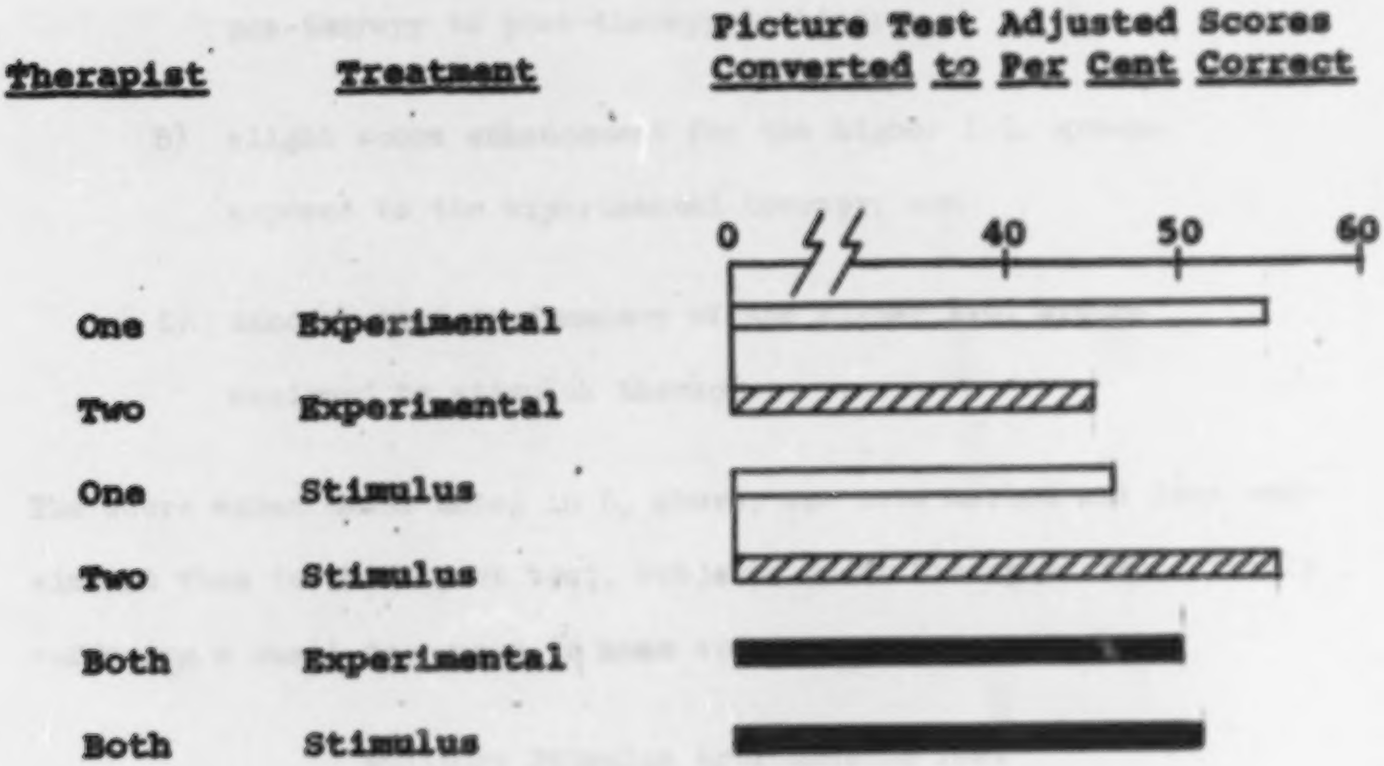

Fig. 4. Interaction of Therapists with Treatments (Methods of Therapy) Revealed by Picture Articulation Test.

The general trends described in the discussion of Figure 2 were found also in the raw data of the picture articulation test, namely:

A) score regression in the lower I.Q. groups from pre-therapy to post-therapy testing;

B) slight score enhancement for the higher I.Q. groups exposed to the experimental therapy; and

C) inconsistent performance of the higher I.Q. groups assigned to stimulus therapy.

The score enhancement noted in B, above, was less marked and less consistent than in the object test, subjects under Therapist Two actually suffering a small decrement in mean score.

Auditory Stimulus Articulation Test

None of the F-ratios calculated in the analysis of covariance of error scores in the auditory stimulus articulation test was found to be significant. Table 16 reveals the general non-significance of these results.

The trends favoring the experimental therapy for the higher I.Q. level subjects and indicating inconsistency for the conventional therapy are continued in this analysis. As in the previous test, Therapist Two's stimulus therapy groups performed better than his experimental therapy subjects, while the reverse was true for Therapist One.

Table 16

Analysis of Covariance of Auditory Stimulus
Articulation Test Error Scores

Source	d.f.	Adj.SSy	M.S. (y.x)	F*
Treatments	3	3931.502	1310.501	1.70
I.Q. Levels	1	2099.648	2099.648	2.73
Trt x Levels	3	929.733	309.911	< 1
Therapists	1	3.637	3.637	< 1
Th x Trt	1	1617.523	1617.523	2.10
Th x Levels	1	836.866	836.866	1.09
Th x Trt x Levels	1	.363	.363	< 1
Within Cells	57	43830.112	768.949	

* Table values of F: .05 (1, 57) 4.01
.01 (1, 57) 7.10

Clarity of Spontaneous Speech Test

Judged clarity of speech appeared to be the least sensitive of the tests used to evaluate the effects of therapy. As shown in Table 17,

Table 17

Analysis of Covariance of
Judged Clarity of Spontaneous Speech

Source	d.f.	Adj.SSy	M.S. (y.x)	F*
Treatments	3	71.156	23.719	1.375
I.Q. Levels	1	39.379	39.379	2.284
Trt x Levels	3	1.123	.374	< 1
Therapists	1	1.653	1.653	< 1
Th x Trt	1	4.515	4.515	< 1
Th x Levels	1	4.824	4.824	< 1
Th x Trt x Levels	1	2.355	2.355	< 1
Within Cells	57	982.904	17.244	

* Table Values of F: .05 (1, 57) 4.01
.01 (1, 57) 7.10

none of the interaction effects and only two of the main effects provided F-ratios larger than 1, and neither of these approached statistical significance. Even the trends discernable in the raw data run somewhat counter to those present in the other test data. For example, the pattern of inconsistency was more characteristic of the experimental groups than the stimulus groups. As in the previous tests, the lower I.Q. test only control group was conspicuous for its decrement in performance on the post-therapy test compared with the pre-therapy test, while the upper I.Q. experimental group under Therapist One achieved the only noteworthy increase in adjusted mean score.

Articulation of Initial / θ /

Analyses of covariance of error scores for the individual consonant sounds were found to be consistent with results reported above for the criterion articulation tests: a general picture of nonsignificance. Table 18, summarizing the analysis for the consonant / θ / in the initial position, illustrates the general trend.

It will be observed that, typical of all measures reported, only the variance attributable to I.Q. levels approached statistical significance. The raw data upon which the analysis of covariance was performed were, in general, in line with trends discussed earlier. However, it is interesting to note that the nearly significant difference attributable to I.Q. levels is one favorable to the lower I.Q. therapy groups. A larger difference between pre-therapy and post-therapy scores was revealed for these groups than for their higher I.Q. counterparts.

Table 18

Analysis of Covariance of Error Scores for Initial / θ /

Source	d.f.	Adj.SSy	M.S. (y.x)	F*
Treatments	3	75.848	25.283	<1
I.Q. Levels	1	139.440	139.440	3.86
Trt x Levels	3	34.538	11.513	<1
Therapists	1	1.552	1.552	<1
Th x Trt	1	53.456	53.456	1.48
Th x Levels	1	58.330	58.330	1.62
Th x Trt x Levels	1	.718	.718	<1
Within Cells	57	2,057.376	36.094	

* Table values of F; .05 (1, 57) 4.01
.01 (1, 57) 7.10

Articulation of Medial / θ /

Table 19 reveals a complete reversal of the observation that reported for articulation errors on initial / θ /. In the medial position this consonant was misarticulated with significantly greater frequency by the lower I.Q. groups than by the upper, as shown by Tables 19 and 20 and Figure 5.

Table 19

Analysis of Covariance of Error Scores
on Medial / θ /

Source	d.f.	Adj. SSy	M.S. (y.x)	F
Treatments	3	57.552	19.184	<1
I.Q. Levels	1	190.114	190.114	5.46*
Trt x Levels	3	34.007	11.336	<1
Therapists	1	4.760	4.760	<1
Th x Trt	1	77.415	77.415	2.22
Th x Levels	1	26.941	26.941	<1
Th x Trt x Levels	1	5.439	5.439	<1
Within Cells	57	1,984.656	34.818	

* Table values of F:	.05	(1, 57)	4.01
	.01	(1, 57)	7.10

The experimental therapy was observed to suffer in comparison with the stimulus therapy in examination of the raw data contributing to this analysis. As on other measures, the subjects assigned to experimental therapy under Therapist One improved more than those assigned to the conventional technique. However, the more conspicuous improvement of Therapist Two's stimulus therapy groups more than offset the minor gains of the experimental therapy subjects.

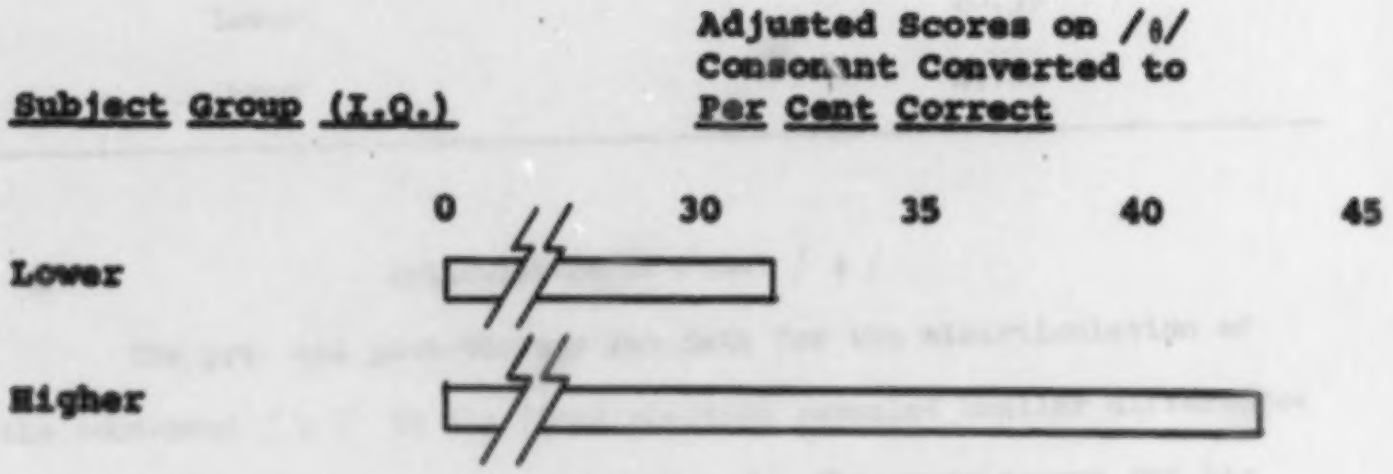

Fig. 5. Effect on /θ/ Consonant, Medial Position, Attributable to Subject Groups (I.Q. Level).

Table 20

Adjusted Mean Error Scores

for Medial / θ /

I. Q. Level	Adjusted Means
Lower	20.55
Upper	17.19

Articulation of Final / θ /

The pre- and post-therapy raw data for the misarticulation of the consonant / θ / in the final position revealed smaller differences than any of the results hitherto reported. The error scores for the lower I.Q. groups assigned to therapy were identical in pre- and post-therapy tests, and the scores for the higher level subjects were nearly so.

As would be expected from this observation, the analysis of covariance for these data, summarized in Table 21, revealed no significant sources of variation. In general, the subjects assigned to Therapist One performed better than those assigned to Therapist Two, and the subjects assigned to experimental therapy (except Therapist Two's lower I.Q. group) did better than those assigned to stimulus therapy. Also, as in all other analyses, the higher I.Q. groups performed materially better than the lower I.Q. groups.

Table 21

Analysis of Covariance of Error Scores
for Final / θ /

Source	d.f.	Adj. SSy	M.S. (y.x)	F*
Treatments	3	99.898	33.299	<1
I.Q. Levels	1	72.772	72.772	2.01
Trt x Levels	3	45.860	15.287	<1
Therapists	1	95.750	95.750	2.65
Th x Trt	1	52.084	52.084	1.44
Th x Levels	1	30.609	30.609	<1
Th x Trt x Levels	1	21.384	21.384	<1
Within Cells	57	2,060.829	36.155	

* Table values of F: .05 (1, 57) 4.01
.01 (1, 57) 7.10

Articulation of Initial /v/

While the total number of misarticulations of the consonant /v/ in the initial position was much smaller than the number of such misarticulations for the consonant / θ /, the same trends -- including non-significance of differences -- were found in the analyses of these data as those reported for the other sound. Table 22 summarizes the analysis of covariance.

Table 22

Analysis of Covariance of Error Scores on Initial /v/

Source	d.f.	Adj.SSy	M.S. (y.x.)	F*
Treatments	3	111.658	37.219	1.329
I.Q. Levels	1	9.119	9.119	<1.
Trt x Levels	3	55.537	18.512	<1
Therapists	1	.193	.193	<1
Th x Trt	1	10.202	10.202	<1
Th x Levels	1	40.536	40.536	1.447
Th x Trt x Levels	1	18.925	18.925	<1
Within Cells	57	1,596.782	28.014	

* Table values of F: .05 (1, 57) 4.01
.01 (1, 57 7.10

Once again, the upper I.Q. subjects were superior to the lower and those assigned to experimental therapy were superior to those assigned to stimulus therapy, but these results were without statistical significance. The most conspicuous (non-significant) improvement in articulation score from pre- to post-therapy tests was noted for Therapist Two's upper level stimulus therapy group.

Despite the non-significance of the F-ratios presented in Table 22, summarizing the analysis of misarticulations of initial /v/, this consonant was uniquely significant in an additional series of analyses. The observation of inconsistent performance between upper and lower I.Q. therapy groups led to the application of a series of t-tests of significance to pre- versus post-therapy scores. In these calculations, the scores of upper and lower I.Q. groups were treated separately and scores of control subjects were omitted entirely. Of the 18 tests so applied, significance (5 per cent level) was found only for pre- versus post-therapy scores for upper level subjects on the articulation of the initial /v/ consonant.

Articulation of Medial /v/

More significance was found in the analysis of data collected in pre-therapy and post-therapy testing of articulation of the medial /v/ consonant than in any of the other consonant analyses. Tables 23 and 24 reveal theese aspects of significance and Figures 6 and 7 graphically illustrate them.

Table 23
Analysis of Covariance of Error Scores
on Medial /v/

Source	d.f.	Adj.SSy	M.S. (y.x.)	F
Treatments	3	24.195	8.398	< 1
I.Q. Levels	1	216.073	216.073	9.59*
Trt x Levels	3	10.902	3.634	< 1
Therapists	1	51.042	51.042	2.27
Th x Trt	1	347.442	347.442	15.43*
Th x Levels	1	21.460	21.460	< 1
Th x Trt x Levels	1	53.978	53.978	2.40
Within Cells	57	1,283.778	22.522	

* Table values of F: .05 (1,57) 4.01
.01 (1.57) 7.10

As revealed in these tables and figures the variances attributable to I.Q. Levels and Therapist by Treatments both were found to be significant at the 1 per cent level. In the former case, the superior performance of the upper over the lower I. Q. groups, noted in all previous analyses, was clearly demonstrated with this consonant.

Table 24

Adjusted Mean Error Scores
for Medial /v/

Therapist	I.Q. Level		Treatment	
	Lower	Upper	Experimental	Stimulus
	13.17*	9.61*		
1 (Female)			9.96	14.61
2 (Male)			13.25	7.14

* Main Effects

The adjusted mean scores in the Therapist by Treatment interaction reveal again the superiority of experimental therapy subjects under Therapist One and stimulus therapy subjects assigned to Therapist Two. The slight difference between the two therapies, favoring the stimulus therapy subjects, appears to be attributable in large part to the superiority of the stimulus therapy group under Therapist Two.

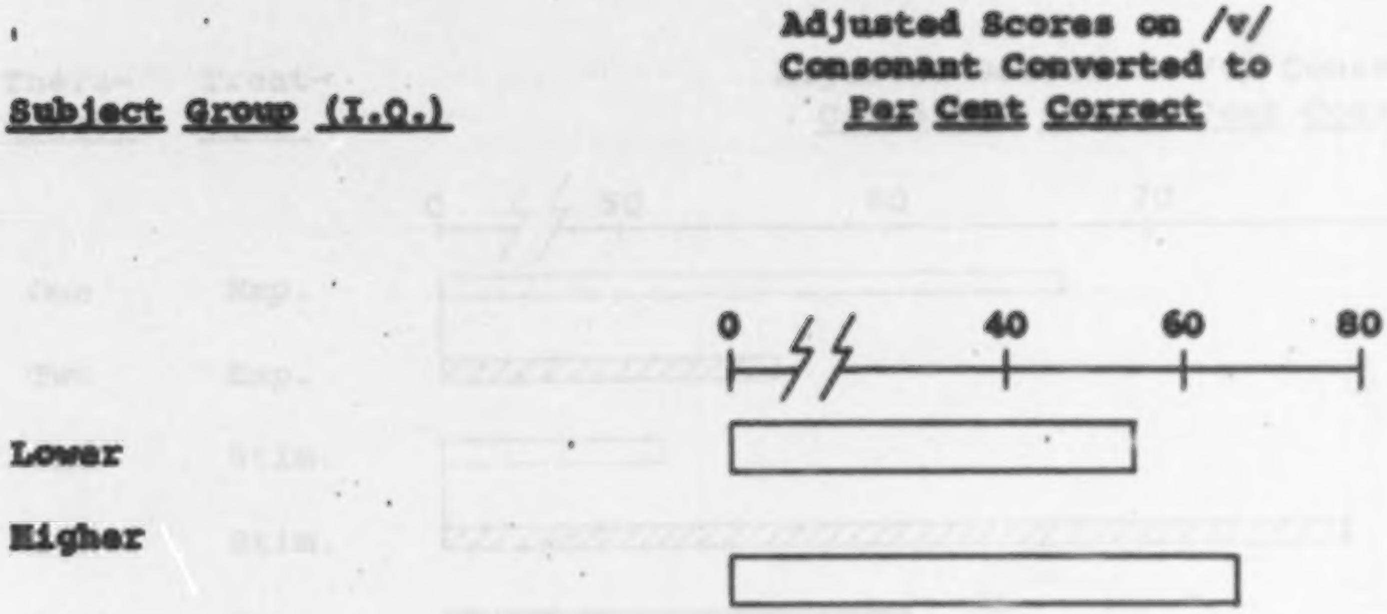

Fig. 6. Effect on /v/ Consonant, Medial Position, Attributable to Subject Groups (I.Q. Level).

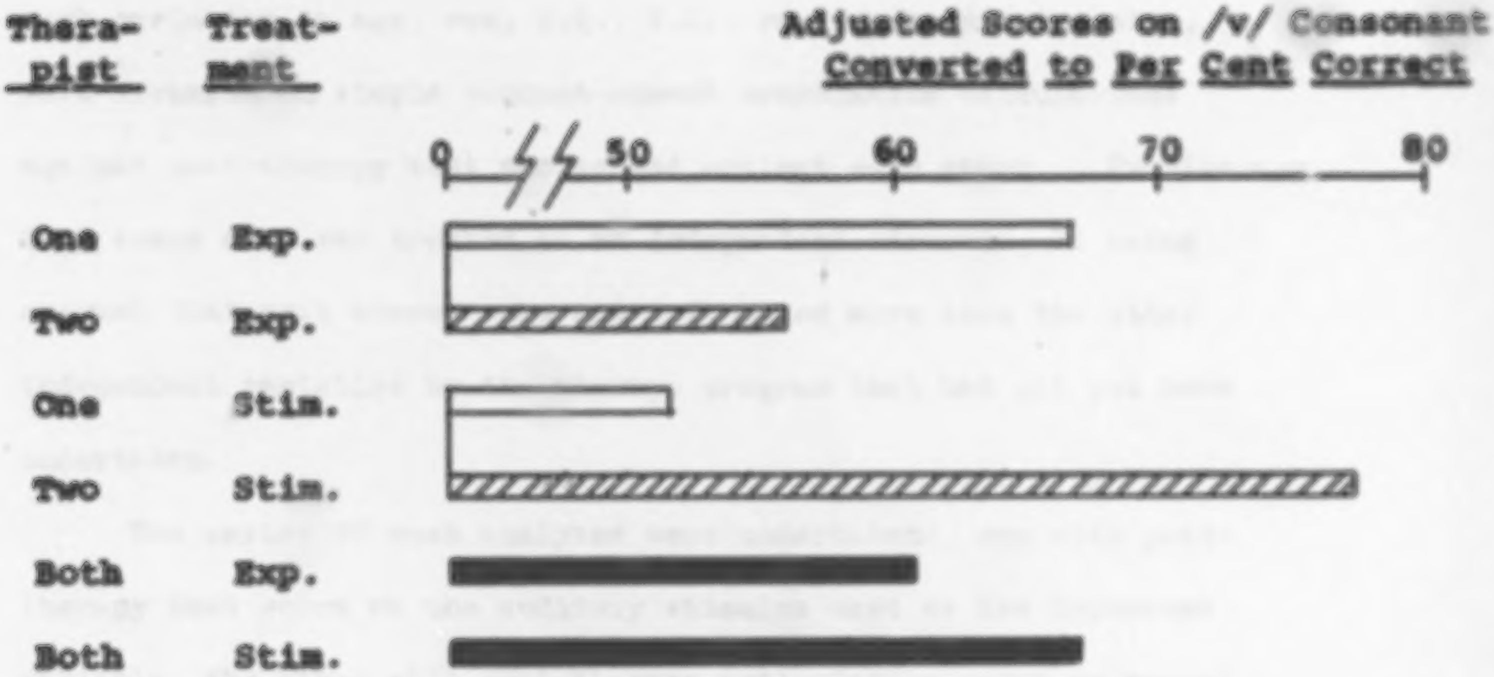

Fig. 7. Interaction of Therapists with Treatments (Methods of Therapy) Revealed by Medial /v/ Articulation Scores.

Correlational Analyses

It was considered desirable, as explained in an earlier section, to discover whether certain characteristics of the subject sample, independent of the influences exerted by the experiment, might prove to be related to the outcome of the investigation. Specifically, such variables as age, sex, I.Q., S.Q., reading readiness, etc., were arranged in simple product-moment correlation calculations against post-therapy test scores and against each other. Pre-therapy test score also was treated as an independent variable, it being assumed that such scores were not influenced more than the other independent variables by the therapy program that had not yet been undertaken.

Two series of such analyses were undertaken: one with post-therapy test score on the auditory stimulus test as the dependent variable, the other with post-therapy articulation score on medial /v/ as the dependent variable. Tables 25 and 26 present the results of these calculations.

Reference to Table 25 shows that only three independent variables were significantly related to the dependent variable. Of these, score on the pre-therapy test was most clearly and most closely related to the post-therapy score. The other two related variables were I.Q. and reading readiness, the former having been the subject of numerous comments in the section devoted to the analyses of covariance. It will be noted that the two variables just mentioned also were significantly related to the pre-therapy test score. Other noted significant relations of general interest outside the context

Table 25

Correlation Matrix with Auditory Stimulus Post-Therapy Test Error Score as the Dependent Variable

	Correlation Coefficients Between Variables *								
	01	02	03	04	05	06	07	08	09
01									
02	.84**								
03	-.02	-.02							
04	.14	.15	-.27						
05	-.24	-.24	-.48	.10					
06	-.43	-.41	-.18	.03	.67				
07	-.39	-.36	.08	.05	.61	.78			
08	-.18	-.19	-.12	.21	.14	.02	.01		
09	.01	-.04	-.06	.01	-.17	-.43	-.34	.03	
10	.01	.19	.12	-.14	-.16	-.08	-.04	-.02	-.11

* Identification of row and column variables:

01 - Post-therapy test error score
02 - Pre-therapy test error score
03 - Age
04 - Sex
05 - Social Quotient
06 - Intelligence Quotient
07 - Reading Readiness Score
08 - Visits to Psychiatrist
09 - Etiological Classification
10 - Family Influence

** Table values of coefficient required for significance:

(N = 49): .05 = .29
.01 = .37

of the experiment were: age and S.Q., I.Q. and S.Q., reading readiness with I.Q. and S.Q., and I.Q. and etiological classification (the higher the I.Q., the greater the likelihood that the subject is in the familial classification).

Table 26

Correlation Coefficients Involving
Post-Therapy Misarticulations of
Medial /v/ and the Independent Variables *

	Correlation Coefficients Between Variables									
	01	02	03	04	05	06	07	08	09	10
01		.60**	.10	.08	-.21	-.34	-.39	-.12	-.09	-.03
02			-.20	-.23	.03	-.22	-.26	-.04	-.03	.06

* Intercorrelations involving all independent variables except pre-therapy misarticulations of medial /v/ obviously would be duplications of the coefficients in Table 25 and hence are omitted. The numbers of variables 03 - 10 are the same as in Table 25, while 01 and 02 refer to post- and pre-therapy medial /v/ misarticulations, respectively.

** The levels of significance presented in Table 25 are applicable to the coefficients in this table.

It will be readily observed that the pattern of significant coefficients present in Table 25, was virtually duplicated in Table 26, except that the relation between pre- and post-therapy scores was slightly lower in the present instance. As before, only I.Q. and reading readiness of the remaining independent variables were significantly related to the dependent variable. A noteworthy difference between the two analyses was the failure of coefficients relating I.Q. and reading readiness to pre-therapy score to achieve significance in the matrix involving medial /v/. It appears that, within the intellectual and reading readiness limits of the sample studied, these variables provide little of predictive value with respect to the misarticulation of a specific consonant sound.

Efforts were made to combine coefficients among the independent variables to enhance the correlation coefficient involving the dependent variable in each of the two analyses just described. A machine modification of the Wherry-Doolittle formula for multiple correlation (18) was employed. By this procedure, maximum shrunken multiple coefficients of .855 and .689 were achieved for auditory stimulus test articulation score and medial /v/ articulation score, respectively. The variables contributing to the formerwere pre-therapy score and family influence; addition of further variables did not significantly enhance the coefficient. In the latter case, the contributing variables were pre-therapy score, age and reading readiness. (It must be pointed out that not all possible combinations of variables were made. It is conceivable that other combinations might have yielded higher coefficients, though this is not considered likely.)

Squared coefficients yield estimates of the total amount of variation in the dependent variable accounted for by the independent variables which contribute. In the present instance, R^2 for the auditory stimulus test score was .732 and R^2 for medial /v/ was .476, indicating that in the former coefficient about 73 per cent and in the latter about 48 per cent of the variation was accounted for by the variables included. It is clear that some influences not tested or controlled in this experiment contributed to the outcome.

Some further information relative to the processes measured was gleaned from calculation of the regression equations for the two multiple correlations. That for the auditory stimulus test was $y = .90x_2 - .73x_{10} + 16.10$, which is interpreted as follows: post-therapy error score equals .90 times pre-therapy score, minus .73 times the arbitrary value assigned to the various aspects of family influence, plus 16.10. Of the variables tested, pre-therapy score was clearly most influential, though it is of some interest to note how family influence was related positively, though indirectly, to the experiment.

With respect to misarticulation of medial /v/, the regression equation calculated was $y = .498x_2 + .0078x_3 - .053x_7 - 1.53$ or, translated into the descriptive terms for the variables: post-therapy misarticulations of /v/ equal .498 times pre-therapy misarticulations, plus .0078 times age, minus .053 times reading readiness, minus 1.53. The contribution of pre-therapy score in this equation was smaller than that above, and a small negative contribution of age (in the sense that increasing age is related to relatively larger error score), as well as a not unexpected positive contribution of reading readiness, are to be noted. It is probable that a slight contribution is made by family influence, also,but the addition of this variable did not provide a significantly larger R^2 than the one for which this regression equation was calculated.

DISCUSSION

Several trends, only occasionally statistically significant, have been discovered in the data and alluded to in the previous section. Further discussion of these and the introduction of certain information under the heading of 'clinical observation' may serve to throw further light on the larger implications of this experiment.

It is clear, for example, that the intellectual levels of the subjects (as measured) were important to the success of both therapies tested. It was the expressed opinion of the therapists employed that the therapy programs were geared too high and carried forward too rapidly even for the upper level subjects. The exigencies of a research timetable made requisite rapid conduct of the therapy plan, but in the normal clinical setting, it is believed, success may be achieved by a more elementary approach and a less rigid temporal control of the program in either of the two patterns described.

Individual differences between therapists, including years of experience, are not to be discounted. Differences in temperament, training, experience, and the poorly defined quality termed clinical skill probably are critical with respect to the choice of one therapy over another and the success of either.

Finally, and probably most significant, the use of the criterion tests necessitated by the experimental design was doubtless somewhat unrealistic when the true objectives of therapy in this setting are examined. It has been noted in a majority of the statistical analyses performed that the experimental (autistic) therapy yielded results that were slightly but non-significantly better than the conventional therapy. What the criterion tests could not reveal were such things as the attitudes, behavior, and adjustment of the subjects, the willingness or eagerness to communicate, the desire to perform up to the limits of capacity. Here clinical observation is important. Both therapists volunteered the information many times in the course of the experiment that the children enrolled in the experimental therapy seemed happier, more alert, more enthusiastic about the therapy sessions, more spontaneous in verbal communication. Though unmeasurable, or at least not measured in the experiment, this aspect of the Mowrer approach is noteworthy. If these behavior characteristics of the subjects enrolled in the experimental therapy are carried over into other departments of their institutional lives, then speech therapy has achieved one of its major goals: adjustment to the environment. Moreover, prospects for placement outside the institution are enhanced if the retardate has the willingness to communicate and the motivation to communicate well, both of which were observed in the experimental therapy program.

SUMMARY AND CONCLUSIONS

An experiment was conducted, testing the effectiveness of two methods of articulation therapy (experimental and conventional) applied by two therapists to two intellectual levels of retardates in a state school for the retarded. Results of therapy were tested by three articulation tests, a test of clarity of spontaneous speech, and scrutiny of the misarticulations of two consonant sounds (the objects of therapy) within the criterion articulation tests. Control groups of subjects were used to provide a basis for judging the effectiveness of therapy.

The two consonant sounds treated in the experiment were initial, medial and final / θ / (as in "thimble,""toothbrush" and "bath") and initial and medial /v/ (as in "visit" and "movie"). These sounds were treated separately in two 20-day periods of therapy, amounting only to five total hours of therapist time per sound per subject.

The experimental method of articulation therapy tested was based upon the Autistic Theory of Language Development enunciated by Mowrer. In essence, the basic hypothesis of this theory is that language development depends upon favorable associations being established in the learner between language generally (words and sounds specifically) and the producer of the language. In application of the theory, Mowrer utilized rewarding food and drink to talking birds as he produced the words he wished them to learn, i.e., stimulus-reward rather than response-award. When the method was applied in the present experiment, the principle of stimulus-reward and situation-reward was employed. The therapists devoted much more than usual effort to the creation of a favorable emotional environment for the application of speech therapy and they provided tangible rewards (e.g., candy) as they, the therapists, produced the consonant sounds that were the objects of therapy.

In some contrast, the conventional therapy against which the experimental method was tested relied upon response-reward (correct sound production by the subjects). Establishment of rapport, an essential feature of conventional stimulus therapy, was not neglected, but the effort to create the favorable association of therapist with sound with pleasurable sensations in the subject was much more characteristic of the experimental therapy than the conventional therapy.

Analyses of covariance, having the effect of equating for initial differences among therapy and control groups, were used to test for the significance of observed post-therapy differences on the criterion tests. In addition, correlational analyses were employed in efforts to isolate independent variables which might have contributed to the post-therapy articulation scores. Such variables as age, sex, I.Q., Social Quotient, reading readiness, and the apparent extent of family influence on the subjects were considered and tested.

The results of the experiment were viewed in two different frames of reference. First, the statistical evaluations were taken into account and conclusions based on them appear below. Second, the clinical observations of the therapists and resident experimenter were examined and certain conclusions were drawn. These, too, appear in succeeding paragraphs.

Certain positive trends were found to recur frequently in the data. While rigid interpretation of the statistical analyses will not, in general, justify broad inferences concerning the effects of therapy in this sample, it is evident that changes occurred in subject performance over the period of time occupied by the program of therapy. Some of these changes are revealed in specific conclusions cited below. These are subject to the usual limitations imposed by the selection of subjects, experimental methods, instrumentation, methods of evaluating results, etc. Even more important limitations have been alluded to previously. These include the limited experience of the therapists (both were in their first year of paid professional experience), the abbreviated period of therapy and the barely satisfactory reliability of the judgments of misarticulation of the criterion consonant sounds.

Subject to the limitations noted, the following conclusions, for which statistical significance was demonstrated, are offered:

A. When an object articulation test is used to evaluate the results of therapy, mentally retarded subjects of the upper intellectual level achieve better adjusted mean scores than the lower level subjects;

B. When a picture articulation test is used to evaluate the effects of therapy, a therapist by method interaction (demonstrated here) may occur. In this instance, the subjects assigned to experimental therapy under the female therapist achieved better scores than their conventional therapy counterparts, while the reverse situation was characteristic of subjects assigned to the male therapist;

C. When the misarticulations of medial / θ /, reported as adjusted mean scores following a program of therapy are examined, the upper level subjects are seen to achieve better scores than the lower level subjects;

D. When a t-test of significance is applied to the difference between pre- and post-therapy mean articulation score for the initial /v/ sound in the upper level subjects, the articulation of the sound is seen to have improved;

E. When the misarticulations of medial /v/, reported as adjusted mean scores following a program of therapy are examined,

   1) mentally retarded subjects of the upper intellectual level are seen to achieve better scores than those of the lower level, and

   2. there is a possible interaction (demonstrated here) of therapist with method of therapy. In the present instance, subjects assigned to the experimental therapy under the female therapist achieved better scores than those assigned to the conventional therapy, while the reverse was noted for subjects assigned to the male therapist;

F. When independent variables are examined by correlational analysis for their relations to the dependent variables (post-therapy articulation scores),

    1) pre-therapy articulation score is seen to be closely related to post-therapy score, and

    2) reading readiness and I.Q. also are seen to be significantly related to post-therapy score;

G. When independent variables are combined in a multiple correlation coefficient,

    1) the combination of pre-therapy score with family influence is seen to enhance the predictive value of the coefficient, auditory stimulus test score being the dependent variable, and

    2) the combination of pre-therapy score, age (negatively related) and reading readiness is seen to enhance the value of the coefficient, articulation of medial /v/ being the dependent variable.

In the second frame of reference, that of clinical observation, the experiment was seen as a very satisfactory test of the efficacy of the experimental approach to speech therapy with retardates. Despite the inexperience of the therapists and the untried nature of the method, it did not suffer in comparison with a standard clinical methodology.

Moreover, even in the hands of the therapist who used it with less success, it was very favorably regarded in terms of the over-all behavior of the subjects exposed to it. They were more favorably disposed toward therapy in general and the therapists in particular than their stimulus therapy counterparts; they became more spontaneously verbal than the other subjects. In short, they became examples of the application of successful therapy in the mentally retarded environment.

Many questions were raised in the course of and by the outcome of the experiment. A few, believed to be critical and subject to experimental investigation are listed below:

1. How may conventional and experimental methods of therapy be revised downward for administration to a population of retardates?
2. Are there real therapist by method interactions, and, if so, is it possible to detect the bases for these interactions?
3. Will sex of the therapist prove to be a decisive factor, or is it merely an artifact of the present experiment?
4. Can more realistic, but at the same time objective, methods of evaluating the effects of therapy be devised?
5. Assuming that such techniques can be devised, will they reveal significant differences between conventional and experimental methods of therapy?

This research experience has been challenging, stimulating and fruitful. It has revealed some of the more important variables which must be controlled or taken into account in research in this area. Most importantly, it has demonstrated the fertility of this field for critical research investigations.

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APPENDIX 1

Object Articulation Test

FORT WAYNE STATE SCHOOL ARTICULATION SURVEY SHEET
(for objects)

AME ______________________ BUILDING ______________
IRTHDATE ______________ I. Q. ______________ DATE ADMITTED ______________
LASSIFICATION ______________________________
XAMINER ______________________ DATE EXAMINED ______________

WORD		PRODUCTION	STIMULATION	WORD		PRODUCTION	STIMULATION
enny	(n)			wagon	(w)		
Valentine	(v)				(g)		
	(n)			yellow	(j)		
atch	(ch)			telephone	(f)		
easure	(ʒ)			bathtub	(θ)		
ather	(ð)				(b)		
ipper	(z)			jar (jelly)	(dʒ)		
irplane	(p)			book	(k)		
rse	(h)			button	(b)		
	(s)				(t)		
chicken	(k)			envelope	(v)		
oe	(ʃ)				(l)		
toothbrush	(t)			white	(ʍ)		
	(ʃ)			pencil	(p)		
ashlight	(ʃ)				(s)		
	(t)			matches	(m)		
owboy	(k)				(ch)		
	(b)			scissors	(z)		
knife	(n)			ring	(r)		
	(f)				(ŋ)		
mmer	(m)			gum	(m)		
	(r)			teeth	(θ)		
c nge	(r)			doll	(d)		
	(dʒ)				(l)		
chair	(ch)			girl	(g)		
s dier	(dʒ)			nose	(z)		
i dian	(d)			thumb	(θ)		
	(j)			hand	(d)		
s ap	(s)			finger	(f)		
	(p)				(ŋ)		
stove	(v)			leg	(l)		
					(g)		

SPECIAL (teeth?)
TCH QUALITY LOUDNESS
YTHM

es he understand directions or any other verbal language?
es he have any language at all (gestures, etc.)?
If he has no language at all, can he imitate you?
es he have any spontaneous language?
Is this language understandable?

OMMENT

APPENDIX 2

Speech Analysis of 1104 Subjects at the Fort Wayne State School, Based on Object Articulation Test

Group	Number Tested	Number of Articulation Errors	Age Group
I	247	Less than 5	16.6 years & over
II	416	More than 5	30 years & over
III	145	5 to 19 - 13 Subjects	Between the ages
		9 to 14 - 31 Subjects	of 16.6 years and
		15 to 24 - 24 Subjects	30 years
		25 to 34 - 14 Subjects	
		35 & over 63 Subjects	
IV	98	0 to 5 - 30 Subjects	6 to 16.6 years
		6 to 9 - 25 Subjects	
		10 to 14 - 21 Subjects	
		15 to 24 - 15 Subjects	
		25 to 34 - 4 Subjects	
		35 & over 3 Subjects	
V	79	0 to 5 - 14 Subjects	6 to 16.6 years
		6 to 9 - 8 Subjects	
		10 to 14 - 14 Subjects	
		15 to 24 - 22 Subjects	
		25 to 34 - 10 Subjects	
		35 & over 11 Subjects	
VI	119	Could not be tested	
Grand Total	1104		

APPENDIX 3

Description of Subjects by Age, Sex
Date of Last Admission and I.Q.

Subject	Age	Sex	Date of Last Admission	I.Q.	Test
1	16.3	M	10/18/56	33	Binet
2	11.7	F	5/25/56	44	Binet
3	9.3	F	3/ 6/57	34	Binet
4	16.1	M	4/24/51	25	Binet
5	13.8	M	5/31/56	30	Binet
6	13.5	M	3/30/54	28	Binet
7	15.7	M	7/ 7/52	21	Binet
8	10.5	M	9/27/56	32	Binet
9	14.7	F	5/11/55	40	Binet
10	13.7	F	5/ 7/52	44	Binet
11	16.2	M	6/ 3/54	29	Binet
12	14.0	M	4/24/51	37	Binet
13	13.9	M	1/12/56	46	Binet
14	11.6	M	10/16/56	48	Binet
15	12.6	F	5/ 2/56	59	Binet
16	11.4	M	10/17/56	52	WISC
17	14.1	M	6/19/57	49	Binet
18	9.3	F	4/ 5/56	62	Binet
19	15.6	M	4/ 7/55	68	Binet
20	9.9	M	7/25/57	52	Binet
21	10.7	M	1/24/55	47	Binet
22	12.4	M	1/25/56	53	WISC
23	10.11	M	1/26/56	55	WISC
24	10.0	F	1/24/56	61	WISC
25	9.3	F	10/20/54	12	Kuhlman
26	12.11	M	12/16/52	29	Binet
27	16.5	F	2/ 6/48	41	Binet
28	12.8	M	4/27/55	35	Binet
29	14.8	M	10/18/56	38	Binet
30	15.7	M	7/18/51	37	Binet
31	14.2	M	6/24/53	66	Binet
32	13.1	M	9/ 2/53	71	Binet
33	12.7	M	1/24/55	55	Binet
34	13.6	F	1/ 8/52	60	Binet
35	11.3	F	9/10/53	50	Binet
36	14.5	M	11/27/51	60	WISC
37	14.4	M	11/27/51	41	Kent EGY
38	12.5	F	1/ 9/52	29	Kuhlman
39	14.8	M	7/29/54	32	Binet
40	16.9	F	8/ 5/47	24	Binet

Subject	Age	Sex	Date of Last Admission	I.Q.	Test
41	12.11	M	12/ 5/56	44	Binet
42	15.3	M	5/ 7/52	35	Binet
43	15.6	M	4/25/51	46	WISC
44	12.6	F	7/ 7/53	50	Binet
45	13.3	M	3/18/52	45	Binet
46	15.7	M	11/13/51	50	Binet
47	12.9	F	12/ 2/53	66	Binet
48	12.8	M	4/ 9/52	47	WISC
49	9.3	M	10/16/56	46	Binet
50	13.11	F	4/25/51	79	Binet
51	16.9	F	6/ 2/49	50	Binet
52	14.1	M	11/27/56	71	WISC
53	13.7	M	3/ 3/52	71	Binet
54	14.4	M	6/19/51	47	Binet
55	16.3	F	6/26/51	44	Binet
56	16.2	M	9/ 9/49	39	Binet
57	8.4	M	5/23/57	43	Binet
58	14.4	M	10/27/44	32	Binet
59	14.3	M	6/24/53	29	Binet
60	15.7	F	12/ 4/50	25	Binet
61	12.1	M	10/ 7/53	58	Binet
62	14.11	F	1/11/51	52	Binet
63	16.3	F	3/16/54	50	WISC
64	14.10	M	9/ 2/53	60	Binet
65	14.7	M	9/10/53	52	Binet
66	12.7	M	1/24/55	59	Binet
67	10.5	M	6/12/56	35	Binet
68	10.4	M	11/30/56	35	Binet
69	14.10	M	11/13/51	39	Binet
70	15.9	M	2/ 1/49	40	Binet
71	15.0	F	10/15/56	40	Binet
72	14.8	M	4/27/55	42	Binet
73					

APPENDIX 4

Rank Order of Articulation Errors

Sound	Position	2	3	Omitted	Substitution	Word Not Produced	Total Errors	Rank
v	Medial	2	4	14	90	13	123	1
θ	Medial	5	0	31	65	6	107	2
θ	Final	3	1	23	73	6	106	3
ʒ	Medial	9	7	6	72	5	99	4
v	Initial	7	3	1	79	5	95	5
t	Medial	0	0	86	5	4	95	6
θ	Initial	3	2	2	78	4	89	7
ð	Medial	3	4	2	74	5	88	8
dʒ	Final	9	6	13	51	5	84	9
ʃ	Medial	26	4	18	27	4	79	10
v	Final	2	0	37	35	4	78	11
z	Initial	17	5	3	49	3	77	12
d	Final	0	0	71	2	2	75	13
z	Final	7	1	29	33	2	72	14
l	Final	5	1	48	4	3	61	15
tʃ	Medial	7	3	6	34	7	57	16
dʒ	Medial	7	7	7	30	6	57	17
s	Final	11	1	16	24	5	57	18
s	Medial	24	2	5	19	4	54	19
z	Medial	10	3	2	28	9	52	20
r	Initial	8	1	1	36	4	50	21
ʌ	Initial	1	0	2	39	7	49	22
tʃ	Final	13	2	11	19	2	47	23
ʃ	Initial	24	2	0	18	1	45	24
r	Medial	16	5	18	1	5	45	25
r	Final	15	5	22	0	3	45	26
n	Final	2	1	6	31	4	44	27
s	Initial	16	3	1	18	4	42	28
tʃ	Initial	4	4	0	25	6	39	29
g	Final	6	3	15	7	5	36	30
j	Initial	1	3	7	17	7	35	31
k	Final	1	0	26	2	5	34	32
l	Medial	0	3	17	2	12	34	33
t	Final	0	2	27	0	4	33	34
l	Initial	3	2	8	15	4	32	35
j	Medial	2	7	13	3	6	31	36
f	Final	0	0	20	6	5	31	37

Sound	Position	2	3	Omitted	Substitution	Word Not Produced	Total Errors	Rank
d	Medial	4	5	15	0	6	30	38
p	Final	2	1	21	1	4	29	39
dʒ	Initial	7	7	0	9	4	27	40
b	Final	1	0	11	0	7	19	41
ŋ	Medial	4	1	5	5	3	18	42
ʃ	Initial	0	2	3	9	3	17	43
ʃ	Medial	2	0	3	5	7	17	44
w	Initial	5	3	3	1	4	16	45
g	Medial	0	1	1	6	4	12	46
ŋ	Final	6	2	1	0	3	12	47
g	Initial	0	2	1	7	2	12	48
k	Medial	1	0	2	6	3	12	49
m	Medial	0	0	3	6	3	12	50
m	Final	0	1	3	3	4	11	51
n	Final	0	1	3	3	4	11	52
n	Medial	2	1	1	2	4	10	53
h	Initial	0	2	4	2	2	10	54
k	Initial	0	2	1	3	2	10	55
p	Medial	1	2	0	3	2	8	56
p	Initial	1	1	0	2	3	7	57
d	Initial	1	0	2	1	3	7	58
ʌ	Initial	0	1	0	2	4	7	59
ð	Medial	0	2	0	0	4	6	60
t	Initial	0	0	1	2	3	6	61
m	Initial	0	0	0	0	5	5	62
b	Initial	0	0	0	0	3	3	63

APPENDIX 5

Test Words and Nonsense Syllables

Words Used in Object Test

1. thumb
2. stove
3. feather
4. ring
5. bathtub
6. envelope
7. button
8. soap
9. orange
10. valentine
11. flashlight
12. teeth

Words Used in Picture Tests

1. bottle
2. thumb
3. valentine
4. red barn
5. washing machine
6. davenport
7. stove
8. toothbrush
9. sun
10. feather
11. orange
12. teeth

Syllables Contained in the Auditory Stimulus Test

1. θæ
2. ʃi
3. θɑ
4. udʒ
5. ʃæ
6. iði
7. iʃi
8. iv
9. ru
10. iθi
11. va
12. ɑθ
13. ɑv
14. ræ
15. idʒ
16. ɑθɑ
17. æʃæ
18. ɑðɑ
19. uvu
20. iti
21. vi
22. ɑdʒ
23. æθ
24. sɑ
25. uðu
26. si
27. æv
28. θi
29. vu
30. æðæ
31. ætæ
32. iθ
33. væ
34. æθæ
35. uθ
36. ɑtɑ
37.
37. θu
38. ivi
39. uv
40. uʃu
41. sæ
42. utu
43. ɑʃɑ
44. ɑvɑ
45. ævæ
46. uθu
47. ædʒ
48. su

APPENDIX 6

Independent Variables Used in Correlational Analysis

Subject	Classification	S.Q.	Reading Readiness Scores	Family Influence	Visit to Psychiatrist
1	N-F*	34	20	8	Yes
2	N-F	56	91	22	No
3	F**	45	0	5	Yes
4	N-F	25	0	6	No
5	N-F	41	7	5	No
6	N-F	34	0	5	No
7	N-F	39	0	8	No
8	N-F	42	19	29	No
9	N-F	51	75	5	No
10	F	54	96	6	No
11	N-F	33	26	30	No
12	F	38	23	5	No
13	N-F	50	71	13	No
14	N-F	58	54	0	No
15	N-F	52	86	6	No
16	F	41	68	39	No
17	N-F	47	93	0	No
18	N-F	71	69	14	No
19	F	45	100	11	No
20	N-F	67	27	1	No
21	F	60	28	0	No
22	N-F	59	83	5	No
23	N-F	71	92	6	No
24	N-F	69	69	13	No
25	N-F	48	0	16	No
26	N-F	36	23	12	No
27	F	42	92	8	No
28	N-F	25	27	20	Yes
29	N-F	21	35	19	No
30	N-F	45	62	9	No
31	F	76	99	17	No
32	F	54	97	12	No

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* Non-Familial

** Familial

Subject	Classification	S.Q.	Reading Readiness Scores	Family Influence	Visit to Psychiatrist
33	F	56	96	5	No
34	F	58	77	7	No
35	F	59	57	18	No
36	F	49	82	20	Yes
37	N-F	57	86	22	No
38	N-F	26	0	5	No
39	F	34	21	41	No
40	N-F	22	15	7	No
41	F	40	46	7	No
42	N-F	44	60	20	No
43	F	49	58	58	No
44	F	37	69	15	No
45	F	54	85	1	No
46	F	51	75	5	No
47	F	53	77	7	No
48	F	58	88	6	Yes
49	N-F	57	28	0	No
50	N-F	55	97	0	Yes
51	N-F	43	95	1	No
52	N-F	44	83	27	No
53	N-F	52	91	0	No
54	N-F	47	31	11	No
55	N-F	38	69	5	No
56	F	41	50	0	No
57	N-F	49	18	15	Yes
58	N-F	26	26	6	No
59	N-F	33	12	11	No
60	F	41	28	15	Yes
61	F	58	56	0	No
62	N-F	39	33	0	No
63	N-F	38	74	6	Yes
64	F	46	98	17	No
65	F	43	93	13	No
66	F	52	91	4	No
67	N-F	58	33	9	No
68	F	53	8	0	No
69	F	31	79	0	No
70	N-F	26	34	10	No
71	N-F	32	59	29	Yes
72	F	32	87	0	No

APPENDIX 7

Words, Pictures, Objects, Nonsense Syllables and Sentence Lists Used in Therapy

A. Word List

/θ/ I	/θ/ M	/θ/ F	/v/ I	/v/ M	
thread	toothpaste	cloth	village	oven	river
thing	nothing	mouth	vegetable	invite	variety
thunder	toothpowder	north	value	prevent	seven
thermometer	mothball	birth	visitor	behavior	silver
thin	healthy	truth	visit	shiver	movie
thanksgiving	birthday	month	vote	governor	cover
Thursday	toothache	bath	vacation	living	deliver
thick	anything	death	voice	never	saving
three	wealthy	south	valley	every	government
throw	something	breath	vase	leaving	evening
thank			violin	avenue	moving
thief				heavy	gravy
think				over	Thanksgiving
thousand				bus driver	even
thimble				private	liver
throat					divide
					eleven

B. Object List

/θ/ I	/θ/ M	/θ/ F	/v/ I	/v/ M
thimble	toothpick		vase	seven
thread	toothpowder		violin	oven
thermometer				
three				

C. Picture List

/θ/ I	/θ/ M	/θ/ F	/v/ I	/v/ M
toothpaste				oven
birthday cake				

D. Nonsense Syllable List

/θ/			/v/	
I	M	F	I	M
θe	IθI	əθ	vɔ	ovo
θɔ	oθo	ɔθ	ve	ɔvɔ
θə	ɔθɔ	Iθ	vI	eve
θo	əθə	oθ	vo	eve
θɛ	uθu	ɛθ	vɛ	IvI
θu	eθe	eθ	ve	ɛvɛ
θI	ɛθɛ	uθ	vu	uvu

E. Sentence List

/θ/

Initial Position:

1. The thief stole the money.
2. Is tomorrow Thursday or Friday?
3. A thimble is used for sewing.
4. Where is your throat?
5. Are you afraid of thunder?
6. Throw me the ball.
7. Thank you for the candy.
8. What color thread do you want?
9. The ice is thin on the pond.

Medial Position:

1. Have you ever had a toothache?
2. Monday is my birthday.
3. Are you healthy?
4. What kind of toothpaste do you use?
5. Why do we use mothballs?

Final Position:

1. It is better to tell the truth
2. Where is your mouth?
3. This is the month of March.
4. Did you drink both glasses of milk?

/v/

Initial Position:

1. We eat vegetables.
2. When are you going on a vacation?
3. Can you play the violin?

4. Put the flowers in the vase.
5. My voice sounds good today.

Medial Position:

1. Put the bread in the oven.
2. Were you invited to the party?
3. Tuesday night we see a movie.
4. His house is on Sunset Avenue.
5. I put gravy on my potatoes.

APPENDIX 8

Daily Lesson Plan, Stimulation Therapy

Following the general plan of therapy described by Van Riper (74), the goal of the lesson plans for the first five days of the stimulation program was ear training.

For the first day the sub-goal was "rapport establishment" and "identification" of sound in isolation and in words. The activity for this day was to show the subject a model of a large clown and explain the formation of the 'clown sound' (the arbitrary name given to the /θ/ sound), in all positions. (The /v/ sound, object of therapy in the second 20 day period, was symbolized by a toy airplane, and the /v/ sound was called the 'airplane sound.') On the second day of ear training, stress was placed on review of the sound in isolation and in words. At this time the therapist repeated the identification and presented the sound in all positions. The subject was also instructed to ring a bell when he heard the sound. An additional motivating device was the wearing of 'big ears' during this session to stress the importance of listening to the sound. The third day of ear training was used to stimulate the sound in all positions. The therapist had objects containing the sound about the room and the subject was asked to find the object. As they toured the room looking for the object, the therapist repeated the words to the subject, speaking louder as they approached the object. (During the third day of therapy for the /v/ sound, the /θ/ sound was reviewed in isolation.) The fourth and fifth days of the ear training program were titled "discrimination." For the fourth day's lesson, the therapist stimulated the child with the isolated sound in all positions. The child was instructed to tap the therapist's right hand when he heard the sound. When the therapist uttered any sound other than the /θ/ (or /v/), the child was to tap the therapist's left hand. During the fifth day, the therapist used sentences with words in which the /θ/ (or /v/) sounds were produced, correctly and incorrectly. The child was to indicate, by touching the therapist's hand, when the sound was correctly produced. (During the fifth day of therapy for the /v/ sound, the /θ/ in nonsense syllables was reviewed.)

On the sixth day of therapy, which introduced the "stimulation" aspect, the goal was to review the identification of the sound as it was produced in isolation. After being stimulated 6 times, the child then was asked to repeat the sound and was rewarded for a good reproduction. The seventh day was devoted to the production of the sound by the child in isolation and in nonsense syllables.

After the Therapist had stimulated the subject with the isolated sound, the subject was asked to repeat it. The same procedure was used for nonsense syllables. The therapist made up a game of this procedure, giving a plus for each correct sound and a minus for each incorrect sound, with a final reward of candy for a majority of plus scores. The goal for the eighth and final day of the "stimulation" period was the correct production of the sound in isolation and in nonsense syllables. During this session the child wore his 'paper ears' and stood with his back to the therapist, who reviewed the sounds in isolation and in nonsense syllables. All positions were presented. When the child heard the sound he would turn around and repeat the syllable. If the child produced the sound correctly he was permitted to walk one step away from the therapist. The object of the game was to get across the room. The /θ/ in nonsense syllables was reviewed during this day of the /v/ therapy session.

The ninth day was the first of a series of 3 days which utilized for "strengthening the sound." On the ninth day, the goal of therapy was to improve the production of the sound as it appeared in isolation and in nonsense syllables.

At the start of the session, the therapist reviewed the sound in isolation. The subject was then instructed to prolong the sound while phonating the sound. Each time the child was instructed to prolong the sound a little longer than in the previous attempt. At the end of this therapy session, the child was rewarded. The tenth day of therapy was a review of discrimination between correct and incorrect productions of the sound as produced by the therapist. The therapist and the subject played a game in which the subject would get a point if the therapist produced the sound incorrectly, and the therapist would get a point if production of the sound was made correctly. It was the subject's task to identify the correct and incorrect productions of the sound. The eleventh day was used for negative practice. Using the sound both correctly and incorrectly, the therapist gave commands which the subject had to answer, repeating the sound exactly as the therapist had uttered it.

From the twelfth to ehe sixteenth days, the goal of the therapy program was the "transition to words." On the twelfth day, when the goal was "signal practice," the child was given a series of words and was instructed to prolong the /θ/ (or /v/) sounds until he heard a prearranged signal, at which time he was to complete the word. The subject was rewarded with candy for a good production. If the child made the sound incorrectly, the therapist called it to his attention and asked him to repeat the entire production. (At the end of the twelfth day during the /v/ sessions, the /θ/ sound as it appeared in words was reviewed.) On the thirteenth day, "rhythm practice' of the sound in isolation in the initial position was practiced. The subject bounced a ball and simultaneously produced the key sound of the word 3 times; then he completed the word. The goal of the fourteenth and fifteenth days of therapy was the production of the sound as it appeared in words. At this time the therapist placed on a table a stack of cards on each of which was a word containing the key sound. The child was instructed to pick a card from the deck and the therapist than read the word. The subject was encouraged to repeat the word. If the subject repeated the word correctly he was permitted to put the card in a box that had been given him by the therapist; if he stated the sound incorrectly, the therapist took the card. If, at the end of a session, the subject had more cards than the therapist, he was rewarded with candy.

On the sixteenth and seventeenth days of therapy, the goal was the production of "words without stimulation." The subject was encouraged to give the therapist words that he remembered from days fifteen and sixteen. In order to facilitate this process the child was shown pictures and objects containing the key sounds. (At the end of the sixteenth day of therapy with the /v/ sound, the /θ/ sound as it appeared in words was reviewed.) The goal of the eighteenth day was the production of words without stimulation from the therapist. A series of objects was placed on the table and the therapist and subject took turns in asking each other to "give me....," and placing the correctly named objects in boxes. When all the objects were gone from the table, if the subject had more objects than the therapist, the child was rewarded with candy.

For the last two days of therapy, the goal was the use of words in sentences. On the ninteenth day, the goal was the isolation of a word within a sentence. On this day, the therapist would utter a sentence in which only one word contained the sound that was being used for therapy. It was the child's task to tell the therapist which word had the key sound, and then to repeat the word. On the last day of therapy, the goal was "conversational usage" of key words in sentences. Both the therapist and the subject used toy telephones to talk to each other, using key words in sentences. If the subject repeated the sound correctly he was rewarded with praise, but if the subject produced the sound incorrectly, the therapist put his receiver down. The therapy procedure was reversed with the subject playing the therapist's role. At the end of the session the child was given a lapel pin stating that, 'I can make the clown (or airplane) sound.' At the conclusion of the last day of therapy for the /v/ sound, the /θ/ sound was reviewed in isolation, in nonsense syllables, and in word combinations.

APPENDIX 9

Daily Lesson Plan, Experimental Therapy

The first five days of the experimental therapy were devoted to giving each child a free play activity period, to create an emotionally acceptable atmosphere. In order to create the warm, permissive atmosphere that Mowrer (48) states is necessary for the learning of language, each subject was given an opportunity to establish a positive relationship with the therapist during the first week.

A variety of materials was made available for the children. On a table in the therapy room were puzzles, games, coloring books, toys, a phonograph and records, crayons, water paint sets, finger paint sets, coloring books and drawing paper. The therapists were instructed to enter into the activities with the children. The subjects were encouraged to talk during these early periods, and the therapists maintained a rather continuous flow of language. The therapist would sit close to the child, and comment on how well he was doing. If at first the child was shy and appeared frightened, the therapist would initiate an activity and encourage the child to help. In order to equate the time schedule for both the /θ/ and /v/ therapy sessions, the first five days of the second period of therapy

(/v/ therapy) were the same as the initial five days of therapy with the /θ/ sound.

During the /v/ therapy program, the /θ/ sound in isolation was reviewed. On the fourth day of therapy, in addition to permitting free play activities, the therapist read stories to the child.

The goal of the sixth and seventh days of therapy was the stimulation of the sound in isolation. On the sixth day the sound was produced 10 times at different time intervals during the session. Immediately preceding the stimulation of a sound, the child was given a reward of candy, or was praised by the therapist for listening to the sound. During this session the child was shown a large picture of a clown for the /θ/ sound (or a picture of an airplane for the /v/ sound). After the child had been instructed to listen for the sound, the therapist uttered the sound and rewarded the child. Then the child was instructed to place a ring on the nose of the clown, or to spin the propeller of the airplane; he was rewarded after he performed this activity. On the seventh day, the therapist again stimulated the subject at least 10 times with the sound in isolation. When the therapist said the sound the child was immediately rewarded. Then the child was instructed to find a bell that had been hidden in the room by the therapist; thereafter, he was told to ring the bell when he heard the key sound.

From the eighth to the tenth days, inclusively, different combinations of nonsense syllables were used to stimulate by means of the key sound in nonsense syllables. On the eighth day, when the child was shown the clown (or the airplane), he was instructed to place a ring on the clown (or to spin the propeller on the airplane) when he heard the sound, presented in nonsense syllables. The child was rewarded after the therapist uttered the sound. (At the conclusion of this session for the /v/ sound, the /θ/ sound in nonsense syllables was reviewed).

For the ninth day, the sounds were again given in nonsense syllables. The child was told to turn his back to the therapist until he heard the therapist make the nonsense syllable at which time he was to turn around. He was immediately rewarded. To focus the child's attention on listening to the sounds, he wore a set of 'paper ears.' On the tenth day also, the goal was the stimulation of the sound as it appeared in nonsense syllables. Each time the therapist uttered the nonsense syllable the child was rewarded and told to toss a ring on a ring stand.

From day 11 through day 15, attention was focused on the production of the key sound in words.

On the eleventh day, the therapist prolonged the consonant in question until the child signaled that he wanted the sound to be completed. At this time the child was rewarded by the therapist. At the end of the therapy session the sound in isolation was reviewed and the child was rewarded after each production by the therapist. The goal of the twelfth day was similar except that the sound was presented in a rhythmic form. The child was given a ball and told to throw it after the therapist had uttered the key sound four times. After the child threw the ball, the therapist completed the word and gave the child his reward.

On the thirteenth and fourteenth days, the child was asked to "fish" out word cards from a box on the table and hand them to the therapist to read. A reward was given as the therapist read the word. Again on the fifteenth day, to stimulate by key sounds in words, the therapist hid pictures and objects which represented words containing the studied sounds. The therapist and the subject toured the room and when one of the objects was found the therapist would name the item and reward the child immediately.

On day 16 through day 18, the child was stimulated with words in sentences. The therapist attempted to utter only one key word in a sentence. On the sixteenth day, the therapist gave the subject a stack of cards on which sentences were written and asked him to, "Give me...." When the therapist read the sentence and came upon the key word, the child was rewarded. The child was then asked to perform the activity mentioned on the cards. (Towards the conclusion of the therapy session of the /r/ sound, the therapist reviewed the /θ/ in word formations). On the seventeenth day the therapist blindfolded the child, and asked him to draw cards from a box. The therapist rewarded the child as the key word was read. The child was then asked to perform the task stated on the cards. This was repeated on the eighteenth day.

On the final two days of therapy, the goal was listening for the sound in general conversation. On these days, both the therapist and the subject held toy telephones to their ears and carried on a conversation. Each time that the therapist used the key sound in a word, the child was rewarded. At the conclusion of the twentieth day of therapy, the /r/ sound and the /θ/ sound were reviewed in isolation, nonsense syllables and word formations. In all conditions of stimulation rewards were presented upon production of the criterion sounds.

APPENDIX 10

Test Forms

SCORING SHEET - OBJECT TEST

Code No.______

Item	Sound	Position	Rating		
			1	2	3
thumb	θ	I			
stove	v	F			
feather	ð	M			
ring	r	I			
bathtub	θ	M			
envelope	v	M			
button	t	M			
soap	s	I			
orange	dʒ	F			
valentine	v	I			
flashlight	ʃ	M			
teeth	θ	F			

SCORING SHEET - PICTURE TEST

Code No.______

Item	Sound	Position	Rating		
			1	2	3
bottle	t	M			
thumb	θ	I			
valentine	v	I			
red barn	r	I			
washing machine	ʃ	M			
davenport	v	M			
stove	v	F			
toothbrush	θ	M			
sun	s	I			
feather	ð	M			
orange	dʒ	F			
teeth	θ	F			

SCORING SHEET - AUDITORY STIMULUS TEST

Code No. _____

Sound and Position	1	2	3	Sound and Position	1	2	3
θæ , I				uðu , M			
ri , I				si , I			
θɑ , I				æv , F			
ædʒ, F				θi , I			
ra , I				vu , I			
iði, M				æðæ , M			
iʃi, M				ætʃæ , M			
iv , F				iθ , F			
ru , I				væ , I			
iθi, M				æθæ , M			
va , I				uθ , F			
ɑθ , F				ɑtɑ , M			
ɑv , F				θu , I			
ræ , I				ivi , M			
idʒ, F				uv , F			
ɑθɑ, M				uʃu , M			
æʃæ, M				sæ , I			
ɑðɑ, M				utu , M			
uvu, M				ɑʃɑ , M			
iti, M				ɑvɑ , M			
vi , I				ævæ , M			
ɑdʒ, F				uθu , M			
æθ , F				ædʒ , F			
sɑ , I				su , I			

CLARITY OF SPONTANEOUS SPEECH TEST

Code No._____

	Rating		
Scoring	1	2	3